The Glass Industry
REG. U. S. PAT. OFF.

Vol. 9 OCTOBER, 1928 No. 10

Comparative Tests on Alumina and Feldspar as Sources of Alumina in Glass

By R. K. McBerty[1]

DURING the past fifteen years, after a great amount of research, the realization of the value of Al_2O_3 in glass has grown rapidly. Due to the many advantages afforded, such as increased strength, greater brilliancy, longer working range and better working properties, many producers are incorporating from one per cent up to three or four per cent of Al_2O_3 in their glass batches, generally either in the form of aluminum hydrate, aluminum oxide or feldspar.

Little information has been available as to the best of these sources of aluminum oxide for glass. Three main factors, however, must be the deciding elements: (a) solubility in the melt; (b) constancy of composition; (c) relative purity.

It is generally conceded that alumina hydrated or calcined, is a more satisfactory material from the standpoints of purity and constancy of composition. The manufacture of these materials is carried on by a process which precludes the presence of more than a trace of iron oxide (.007% is the average Fe_2O_3 content). Combined moisture is practically constant in either the hydrated or the calcined product.

Feldspar, on the other hand, is a mineral of igneous origin, and consequently shares the variations in composition common to all mined and quarried products. The amount of feldspar used in a batch, will be nearly five times the percentage of alumina desired. Thus, small variations in the composition are really important. Since .2 per cent Fe_2O_3 is the upper limit for a high grade glass, a feldspar must be carefully watched, to avoid contamination of other ingredients. No data being available as to the relative solubilities of these two materials, experimental work, described below, was undertaken to determine their respective merits.

For experimental purposes, two types of glass were selected as the most likely to give generally applicable results. Of these, the sodium borosilicates, and the soda lime silicates, the latter is of course of greater economic importance.

Calculated analyses of the glasses made up, are given in the following table:

	B-1	B-2	L-1	L-2	L-3	L-4
SiO_2	68.0	59.4	68.0	64.6	65.9	64.8
B_2O_3	13.6	16.7	...	...	...	...
Na_2O	7.5	10.1	12.8	14.2	14.6	17.0
K_2O	3.4	4.3	3.6	3.9	4.0	3.4
Al_2O_3	7.5	9.5	7.8	8.7	4.4	7.4
CaO	...	...	7.8	8.6	11.1	7.4

Except in special cases, batches of 100 grams glass equivalent were fired in fire clay crucibles, in a gas-fired muffle furnace. Pairs of batches (one incorporating feldspar and the other alumina) were placed side by side so as to be equally heated. Temperatures were taken with a thermocouple. Preliminary mixing was done by hand. Commercial materials used were ground quartz, feldspar, alumina and salt cake (sodium sulphate).

Other ingredients were pure laboratory stock. Analysis of the commercial materials is given in the following table:

	SiO_2	Na_2O	K_2O	Al_2O_3	Fe_2O_3	
Silica	99.6	..	..	..	..	%
Feldspar	67.0	3.6	8.5	18.5	.25	%
Hydrated Alumina	..	..	..	65.8	.007	%
Salt Cake	..	41.8	..	..	.30	%

The melting procedure was to place the batches in the furnace at 1,300 degrees Centigrade, heat the furnace up to 1,400 degrees in one hour, withdraw a small sample by means of a silica rod, and either continue the heating at the same rate or remove the batch, as microscopic examination of the sample indicated.

The borosilicate glasses were made up according to the following batch formulas:

	B-1			B-2		
	a	*b*	*c*	*a*	*b*	*c*
Feldspar	40.0	...	...	50.3	...	...
Borax	27.0	37.5	37.5	45.6	45.6	45.6
Silica	41.0	68.0	68.0	25.2	59.2	59.2
Soda	2.9	2.4	2.4	1.6	4.7	4.7
Potash	...	5.0	5.0	...	6.3	6.3
Hydrate alumina	...	11.4	...	...	14.3	...
Calcined alumina	...	...	7.6	...	...	9.5

The batches B-1, a, b and c, were rather viscous at tem-

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perature of 1,480° C., and microscopic examination showed that the aluminum hydrate was the first to go completely into solution. Due to the index of refraction of the feldspar particles being so nearly that of the glass, observation without the aid of a microscope would not substantiate this statement. Furthermore, the transition from true feldspar to true glass was so gradual that it could be observed only with the aid of polarized light. These undissolved particles of feldspar though not obvious are physically detrimental.

Batches B-2, a, b and c, though melting at lower temperatures, gave the same results.

Small batches, of analysis B-2, were made up and fused in crucibles of pure calcined alumina. The differences in color of the final glasses gave a clear distinction between the alumina glasses and the feldspar glasses, the alumina glasses being only very faintly yellow, while the feldspar glasses were of a pronounced green. This was to be expected, due to the greater amount of iron from the feldspar entering the feldspar batches and indicates use of less decolorizer for the hydrate of alumina glasses. Soda lime glasses were made up after the analyses L-1, L-2, L-3 and L-4. Batch analyses are shown below:

	L-1		L-2		L-3		L-4	
	a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
Feldspar	42.5	...	46.6	...	23.8	...	40.0	...
SiO_2	39.5	68.0	33.4	64.6	50.0	66.0	38.8	64.8
Soda	19.5	22.0	22.3	25.0	23.5	25.0	27.0	29.0
Potash	...	5.3	...	5.7	2.9	5.8	...	5.0
$CaCO_3$	14.0	14.0	15.3	15.3	20.0	20.0	13.2	13.2
Alumina	...	11.8	...	13.2	...	6.7	...	11.3

In the batch formulas given above, the alumina is all in the hydrated form. A few batches were made up with the calcined material, but as they were not so readily dissolved, the remainder of the work was carried on only with the hydrated alumina and the feldspar.

In soda lime glasses, in many instances, more or less of the sodium is derived from salt cake (sodium sulphate). Little information could be found as to the correct proportions of soda ash, and salt cake, so various mixtures were tried, to determine the difference in effect. The above batch formulas give the Na_2O in terms of soda ash (anhydrous). The equivalents of salt cake were determined by dividing the soda values by .72. The carbon added to decompose the salt cake, was at first calculated to form the sodium sulfite. This amount was found insufficient in the case of the feldspar batches, and in these was increased. Carbon was added in the form of wood charcoal previously dried and ground. Melts of analysis L-1 were made up both with salt cake and with soda ash. Results were the same in both cases. The batches were heated from 1,300 degrees to 1,550 in three hours, and at no time were completely melted. On being removed from the furnace they proved to be badly crystallized, the alumina batches more so than the feldspar. L-4 is the same analysis as L-1, save for an increase in the Na_2O content. When heated rapidly a good glass was obtained, but if heated slowly, the same results were produced as in the previous run; the crystallization being more pronounced in the salt cake batches.

The L-2 batches were made up with soda ash, with salt cake, and with mixtures of these. In several cases cullet was added to the extent of twenty per cent.

In the batches using soda ash, the alumina hydrate melts were the first to go completely into solution, though there was very little difference. The greater the amount of the soda ash replaced by salt cake, the more easily the feldspar batches were dissolved compared to the alumina batches. When no soda ash was used at all, the hydrate of alumina glass was still milky when the feldspar glass was homogeneous. The addition of cullet was favorable to the more rapid solution of the alumina.

In L-3 batches, in which the alumina was decreased, and the lime increased, the results were the same as the above, but differences were not so pronounced. In the L-2 and L-3 batches, the feldspar glasses were the first to be completely dissolved but this glass was found in all cases to be badly discolored by free carbon. That this was not due to incorrectly calculated carbon content, was proved by a series of melts, analysis L-2 both with alumina and with feldspar, in which the carbon content was varied from, less to more than the calculated requirements. The alumina batches were colored only when excess carbon was used. The feldspar batches were brown to black, in all cases, and a button of salt cake remained undecomposed.

This discoloration diminished with prolonged heating, or with considerable increase in temperature over that required to obtain a clear glass from the alumina batches. It was found that the feldspar batches foamed badly, thus allowing the segregation of the already-melted salt cake, with the result that considerable of the carbon remained unused. This foaming was due to the relatively low initial fusion temperature of feldspar, which then remained very viscous up to about 1,500 degrees C. The feldspar glasses thus had their maximum viscosity during the earlier part of the melting process, the viscosity decreasing as the salt cake was decomposed. With the hydrate of alumina glasses, the case was reversed, and the first glass was very high in Na_2O, giving a minimum viscosity, thus allowing the early release of the gas bubbles.

The alumina contents of these glasses was probably higher than commercial practice would indicate, but were intended so, in order that the results would be exaggerated for better observation. In melts of lower Al_2O_3 content, the results were the same but were not so readily distinguishable.

The foregoing data indicate that in glassmaking:

Hydrate of alumina has an equal or greater solubiilty than feldspar when the soda content of the glass is derived from soda ash.

Feldspar has an advantage in solubility over hydrate of alumina where all soda contents are derived from salt cake.

Where the soda contents are derived from both soda ash and salt cake, the advantage of one over the other is proportionate to the mixture.

Both hydrate of alumina and feldspar are more soluble than aluminum oxide.

Hydrate of alumina has the advantage over feldspar as to uniformity of composition.

Hydrate of alumina on account of its purity has advantage over feldspar in the color of the finished glass.

Viewpoint of a Feldspar Advocate on Feldspar and Alumina As Sources of Alumina In Glass

Believing that our readers after enjoying the preceding article would be interested in a discussion of the subject by a representative of the feldspar industry, an advance proof of Mr. McBerty's article was submitted to V. V. Kelsey of the Erwin Feldspar Company, Inc., Trenton, New Jersey and his comments invited for publication. What he has to say follows.—EDITOR.

By V. V. Kelsey

MR. McBERTY'S article giving the results of comparative tests on alumina and feldspar as sources of alumina in glass is quite timely and very interesting. We agree with him regarding the constancy of composition and the relative purity of aluminum hydrate and aluminum oxide being somewhat greater than feldspar. The progressive feldspar concerns who are today preparing feldspar under technical control are able to place on the market a material of high purity and uniformity. It is necessary, in order to accomplish this, that the spar be selected with considerable care, carefully milled and supplemented with rigid technical control. By so doing, the progressive feldspar producer has greatly improved his product over that marketed a few years ago.

The maximum amount of iron oxide permitted by practically all the glass manufacturers using feldspar today is a tenth of one per cent. This maximum is rarely ever exceeded by producers who have close check on the quality of their output. This being the case, the iron content in feldspar is very much below the upper limit allowed for a high grade glass.

Feldspar has a composition closely approaching that of some types of glass, the result being that this material quickly unites chemically with the other glass-making ingredients, and, in this respect, functions to a considerable extent quite similar to cullet. In other words, the alumina, potash and soda in feldspar have already gone through a melting process in nature to the extent that they are chemically combined with the silica to form a definite silicate. Therefore, the alumina is already in solution.

It is a known fact that feldspar goes into solution quickly in the production of glass on a commercial basis in either pot or tank furnaces, none is lost and none remains undissolved. It is also known that glass having a desired chemical composition, calculated to contain a certain predetermined percentage of alumina, can be easily had with the use of feldspar. In other words, a ton of feldspar will make a ton of glass, showing conclusively that all the alumina in the feldspar quickly dissolves and becomes a part of the finished material.

A number of glass manufacturers have found that if they add a certain percentage of aluminum hydrate or aluminum oxide to the glass batch, and later make a careful chemical analysis of their finished glass, they do not find as much alumina as they should, thus proving that a certain percentage of the hydrate or oxide still remains undissolved in the tank. Feldspar has another marked advantage in that it is easily handled and readily mixed with the other glass-making ingredients.

Recent Improvements in the Manufacture of Flat Glass*

AT the Spring Meeting of the A.S.M.E. in Pittsburgh, a paper† on the above subject was presented by H. K. Hitchcock, Consulting Engineer, Pittsburgh Plate Glass Company. The object of the paper, the author stated, was to touch on the early methods of making sheet glass; point out the generally accepted methods used; and briefly outline the most recent developments in the industry, giving references to the literature on the subject, so that those interested in it might be able to get in touch with the general line of this development without exhaustive search.

The author dealt first with the primitive, hand-operated ways of producing flat glass by spinning, blowing, and casting; the development of the use of power-driven machinery in casting, blowing, and drawing; and finally with the development of the continuous method of casting from tanks and grinding and polishing, with a brief description of an improved method of casting from pots. The paper, which was published in the May, 1928, issue of *Mechanical Engineering*, p. 368, was the subject of much discussion. Of this, an extended written communication which was submitted and excerpts from the report of the session, follow.

J. W. CRUIKSHANK.[1] The author states a continuous ribbon of glass is made of a width up to 10 ft. The writer would like to ask where this has been done. It is a question of great interest whether glass can be rolled continuously from a tank in widths over 6 ft. Of course, theoretically, there is no limit to the width of the sheet produced by flowing glass from a tank and passing it through rolls, but in practice, based on the assumption that this process is similar to others, the width makes a great deal of difference. For example, in the annealing of glass in the leer and in the grinding and polishing on continuous tables, the difficulties increase enormously as the width is increased.

Referring to the melting tanks in which the author states the glass is of satisfactory quality at the beginning of the run, but becomes less and less so as the blocks wear away, the writer would ask whether this deterioration in quality is entirely due to the wearing away of the refractory materials of the tank or is due in part to devitrification in the mass. He has never been able to understand how a good

* From *Mechanical Engineering*, October, 1928.
† See THE GLASS INDUSTRY, May, 1928, pages 105-109.
[1] J. W. Cruikshank Engineering Co., Pittsburgh, Pa.

quality of metal can be produced from a continuous melting tank, although he knows it is done.

The depth of the molten glass in a tank furnace is some 60 in., and it has been demonstrated that only the surface is flowing. This would seem to indicate that poor and devitrified glass must at times rise up from the mass and get into the flowing stream. It would seem impossible to produce good glass continuously under these circumstances. The ideal way would be to keep a shallow flowing stream and use up all the glass that is in a molten condition. Unfortunately, this is impracticable and impossible unless some super-refractory can be provided which will resist the fluxing action of the glass materials.

Devitrification is one of the most difficult things to contend with in a tank, and while good progress has recently been made in improving the materials so that there is less liability to devitrification, it is one of the enemies of the continuous process. This is more especially true in such machines as the Fourcault where, in the bath from which the glass is drawn, and in the channels leading to it, the temperature of the glass has to be reduced to the temperature requisite to produce the correct viscosity for the production of the sheet of glass. This is where the American Window Glass Company has a distinct advantage in its process in that the temperature of the glass is kept well above the point of devitrification, at which temperature the glass is ladled from the tank and removed in the ladle to the cylinder-forming machine. It is during the time the glass is in the ladle, and in the pot from which it is drawn, that it has a chance to cool down to the correct temperature to give the required viscosity for drawing.

On the other hand, in the case of the Fourcault-type process in which the glass is drawn directly from a bath in connection with the main body of the metal in the tank, the fact of cooling the glass in order to condition it to the desired viscosity for drawing, at a comparatively low temperature of below 1900 deg. fahr., and the holding of it in a molten state at this temperature, tends toward devitrification. These conditions make a modification of the batch necessary, with a proportionate reduction of the lime. The writer would like to ask if the same conditions are not encountered, to a lesser extent, in the rolling of sheet glass directly from the tank. They are, he knows, at the Ford Motor Co. where they have to use a slightly softer batch than in plate glass.

The author did not mention the process of the Ford Motor Company for rolling glass from a tank. This is an extremely ingenious invention known as the "unconfined pool," and the writer would like to draw attention to it as it is considered to be the pioneer process for the production of plate glass by the continuous method. The process is well known, and is open to general inspection at the plant at River Rouge.

The Ford Motor Company in 1919 built a small glass plant at Highland Park, adjoining the Ford automobile factory, to experiment on methods of producing plate glass. The final outcome of the experiments was the installation of a small melting tank furnace, and two lines of continuous traveling tables on which the glass was ground and polished. The idea was to produce automobile wind shields, cut to size in the rough plate, so that when the glass was ground and polished the result would be equivalent to finished wind shields. An immense amount of trouble was experienced with their tank, but eventually, in the latter part of the year 1921, they were rewarded with a measure of success.

The River Rouge Glass plant, built in 1922, consisted of an equipment of four melting tanks 78 ft. long by 16 ft. wide with a complement of continuous grinders and polishers. This plant was designed for the production of ten million feet of polished plate glass per annum. The glass from these tanks is rolled out in a continuous sheet 42 in. wide, which passes directly into and through an annealing lehr, equipped with rollers, provided for each tank. The glass delivered to the rolls from the tank flows through a narrow channel in which a sluice gate is provided. The volume of the flow is controlled by the level of the glass in the tank. This level is exactly regulated by feeding the batch materials to the melting end of the furnace at carefully timed intervals so that the exact level is maintained. The molten glass flows from a refractory chute on to a comparatively large roller 48 in. in diameter, which is the equivalent of a revolving casting table and is rolled out into a sheet by a small roller placed over it. The first apparatus used at the Highland Park plant was actually a traveling casting table in the form of an endless belt with iron slabs connected by chains passing around sprockets with the roller revolving over it. The width of the sheet is controlled by the peripheral speed of these rollers, or the traveling casting table and its roller, and is a function of the rate at which the glass is flowing from the chute from the tank. The operator constantly gauges the width of the sheet; if it becomes too wide, the rollers are speeded up by a delicate control of the electric motor. If, on the other hand, it becomes too narrow, the relative speed of the rollers is decreased. This device is extremely ingenious and is described in U. S. patent No. 1,556,665 to Avery and Brown. An attempt was made to control the width automatically by electrical means. For this purpose small fingers or rollers were provided on each side of the sheet; depending on variation in the width of the sheet these fingers caused electrical contacts to be established, which, operating through relay control, regulated the speed of the motor. This, however, was abandoned in favor of the former manual method of control.

An interesting patent, U. S. 1,532,704, issued to Le Mare, assigned to Pilkington Bros., England, very clearly illustrates the action of the glass in its flow from a chute on to a traveling casting table which, as noted above, has been replaced by a roll. The object of this patent is to provide a method for keeping the edges of the sheet from becoming chilled; a precaution which would probably be necessary in a sheet of glass wider than that made at the Ford Motor Company's plant at River Rouge.

The grinding and polishing of the 42-in.-wide rolled glass from each tank furnace is done on two lines of tables, each traveling under a series of grinders and polishers. One of these lines is for grinding and polishing the first side and the other for finishing the second side. The tables, before

they are coupled together, are 113 in. long. When first this plant was started the continuous sheet of glass coming from the annealing leer was cut into lengths of 113 in. and laid on the individual tables before they were coupled to the line. This method, which was employed for some time, was later changed in favor of laying the rough plate sheets in any convenient length on the moving line of coupled tables. The advantage of this latter system is that the glass is laid in any size in which it is cut for obvious defects especially for stone which would cause the sheet to break under the grinders. A further advantage is that when breakage occurs for any cause, pieces of glass do not have to be found of the exact size to match up the broken pieces on the individual tables. The latter method of keeping the rough-plate sheets in as large sizes as possible is similar to that practiced in the plate-glass factories of the intermittent casting system, where sheets from 200 to 300 sq. ft., are produced. The object of performing a minimum of cutting on the rough plate before the grinding and polishing is that obviously after the glass is transparent, defects can much more readily be seen. The author has described a very clever and unique arrangement of examining the continuous sheet of glass as it travels from the annealing leer with the use of nicol prisms by which defects can be detected. He also states that the glass is cut in "standard lengths so that instead of having a big variety of sizes which it is necessary to grind and polish, practically all of the glass which goes into the grinding and polishing departments is of standard sizes." It is evident from this statement that there are few defects found in the glass when examined at the end of the lehr, and that most of it can be cut to sizes which will afterward cut to best advantage in the finished product.

The method of handling the glass described by the author in laying and removing it from the tables of the continuous grinders and polishers, is very ingenious and well developed. However, it would seem that too much emphasis is being placed on the methods employed in the new system, for, with the exception that in the grinding and polishing department the tables are continuously moving under the grinder and polisher heads, replacing the round tables and intermittent operation, there are many features in which there is little novelty. The grinders are the same with iron-shod runners using varying grades of sand and emery. The polishers have felt-covered blocks with circular runners the same as used in the round type of machines. The carrying of the glass sheets may be considered to have been one of the greatest improvements in the industry before the continuous system was thought of, and was of immensely greater benefit in the handling of the large sheets of glass some 12 ft. high by 20 ft. wide, than the handling of the smaller sheets in the continuous system which is only a matter of efficiency. A gang of sixteen men carrying a sheet of glass weighing some 1500 lb., formerly employed in the old system, was later replaced by a traveling crane and a small clamp carrying the sheet. This was a notable stride in the industry. The vacuum cups to remove the sheets from the table were also developed and have been in use in most factories in Europe for a considerable time, and have also been used with a different form of apparatus in several plants in this country. The sand grading, and the dipping and cleaning of the glass were all previously in use, modified somewhat to suit the new conditions of continuous grinding.

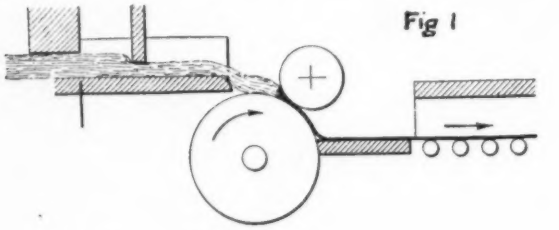
In regard to the question of the melting of glass in pots rather than the employment of the continuous melting tank furnace, the writer has long held the opinion, and it would appear that the author is in agreement, that the pot method is superior. There is some development going on at the present time with the continuous tank, and installations are being worked out in England and in continental Europe which the sponsors are confident will be successful. For this reason it is difficult to obtain from those conversant with the glass industry, any admission that the tank is not superior and has not more economic possibilities than melting and rolling glass produced in pots.

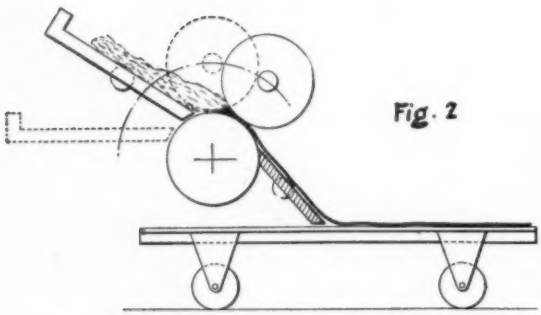
Plate glass, as the author has explained, has always been melted and refined in pots in pot furnaces, and, up to a few years ago, the average plate-glass superintendent and technical man has always maintained that it was impossible to produce the quality required by the use of the continuous melting tank. It has now been demonstrated that this, to a certain extent, is a fallacy and the enthusiasts point to the window-glass and bottle-glass development as a precedent in the industry, where the same conditions prevailed at one time and the old-fashioned people connected with the industry believed that the pot was the only thing, more especially for glassware where high quality was the desideratum. However, in the plate-glass industry, the conditions are such that if by modern methods and the casting between rolls, such as the author has described, a thinner sheet of glass can be produced of approximately double the area from a pot, then the unit cost of the glass will be approximately cut in half. Some of the items of cost must necessarily be higher in the pot furnace than in the continuous melting tank; the consumption of fuel is undoubtedly slightly greater, and the cost of pots is a considerable item, but these differences are probably more than offset by the lower cost of repairs to the pot furnace, and the loss of glass and resulting increase of cost when the glass in the tank goes bad. In the case of pots there is always an opportunity to correct this bad quality when such develops, as each furnace is a unit in itself and each pot again a unit of the whole; whereas the tank, containing tons of metal, may have to be shut down, or an immense amount of glass drawn from it to correct the unfavorable conditions.

The method of casting the pot of glass, pouring it between rolls forming a comparatively thin sheet of large area, and then cutting it up, was first introduced by Max Bicheroux in the factory of which he is manager near Aix-la-Chapelle, Germany. Mr. Bicheroux started with the idea of making a number of smaller sheets from a large one by the regular plate-glass process of rolling on a casting table and then cutting up the sheets. He later developed the system shown in Fig. 1 which is described in his English Patent No. 182,551 and also in U. S. Patent No. 1,665,427 recently issued to Von Reis.

Referring to Fig. 1, the upper inclined plane at the left is the tilting casting table or slab. Glass is poured from

the pot on to this slab when it is in an approximately horizontal position. This slab tips up and is connected to the upper roll so that the two tip together. The glass is thus delivered to the rolls which revolve and the glass is passed between them and delivered as a sheet on to this lower inclined plate. There is a table mounted on wheels which





travels at the same speed as the glass sheet coming from the inclined slab which is delivered on to the table and picked up by it. The table continues to travel over toward the annealing lehr, where it is pushed over toward the oven of the annealing lehr into which it is pushed. Recent patents on this device show a roller in the upper casting table slab so that the glass is fed to the rolls. They also have a roller to help the glass down the lower inclined plane to the traveling tables.

In the Ford process (Fig. 2), a chute leads from the glass-melting tank to a large roller. A small roller located above it rolls the glass against the larger one. The metal flows down continuously from the chute which is formed of refractory material, the flow being dependent on the regulation due to the level of the metal in the tank. The glass passes between the rolls and forms a sheet which passes to a series of rollers into the annealing lehr through which it continually travels to the other end. The large roller is water-cooled, the water being kept always at the same level due to the fact the outlet at the end of the roller is larger than the inlet on this side. The glass forms a pool from which the sheet is formed, the width of which is determined by the speed of the rolls and the quantity of glass that is delivered from the chute from the tank. A man provided with a gauge measures the width, and if there is a variation it is regulated by the electric control of the motor.

The great point of saving in this system is the superiority of glass made in this manner, in that it is not only thinner, but has a more even thickness than the glass made by the old method, as well as being much straighter and flatter. The saving resulting from these qualities is very considerable in the grinding and polishing operation. Apparatus for rolling glass which is a modification of this system has been and is now being installed in several plants.

WALTER N. OAKLEY.[2] Some one has said that melting glass is analogous to melting ice in a vessel of sugar, and it is a fairly true analogy. Tank blocks in this service are made largely of clay mixtures composed of silica and alumina. As glass is highly reactive toward these materials at high temperature, a very serious corrosion problem exists. The temperature between the glass and blocks has to be accurately adjusted in order to minimize this corrosion. If the glass dissolves the blocks very badly it will spoil the glass. In order to minimize this attack the blocks are cooled on the outside and this in turn tends to cool the glass in the tank at the inside surface, and decreases melting rates.

Many attempts have been made to decrease this corrosion by adjusting clay mixtures so that they will have lower porosity and greater uniformity. Quite recently blocks were placed on the market which are cast from electrically fused mixtures. The porosity in this case is zero. These blocks wear at the rate of ouly a third of the ordinary clay blocks. Their use presents some very interesting possibilities to the glass manufacturers and users of processes involving molten materials.

W. TRINKS.[3] In the paper mention was made of the efficiency of the tank. Tanks are very inefficient now. If we consider the tank a machine, it has an efficiency of only 6½ or 7 per cent.

I disagree with one statement made in the paper, namely, that in the Libbey-Owens process the knurled rollers are there for the purpose of rolling down the glass. In this process the water cooling produces a stiff beam of glass which has sufficient strength against bending so that between the edges where the knurls are they roll the glass thinner; the final result is that the edges are a trifle thicker. The difficulty is to have the glass cold enough when it reaches the roller so that it will not be deformed too seriously and not lose its fire polish, and yet have it soft enough so it will bend over the roller without breaking or cracking.

W. L. ABBOTT.[4] Glass making is a very old industry as compared with other industries which are much larger. Glass makers are still groping with fundamental problems, and why? It is because they do not attend professional society meetings and freely interchange ideas as the steel men, the steam men, and the electric men do. They prefer to keep their troubles and their successes carefully guarded within their own walls and not to seek aid of their neighbors who have the same trouble and the same problems. It seems to me that if they would interchange information about what they have achieved and where they have failed that they would soon attain the success which has been experienced at the River Rouge Plant, where the advancement has been phenomenal.

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[3] Professor of Mechanical Engineering, Carnegie Institute of Technology, Pittsburgh, Pa. Mem. A.S.M.E. and Chairman of Session.
[4] Chief Operating Engineer, Commonwealth Edison Co., Chicago, Ill. Past President A.S.M.E.

Health Hazards of the Glass Industry[1]

By M. M. McMahon[2]

(*Continued from the September Issue*)

Decorated Glass

THIS branch of the glass industry has become very important in the last few years. As the vogue for heavy cut glass has declined, the painted and gold and silver encrusted ware has taken its place.

Many of the processes used in this trade are similar to those used in decorating china, and more women are in these shops than in any other kind of glass factory except electric bulb plants. In five factories visited 153 women were employed, most of them at the different decorating operations and at washing, cleaning, packing and inspecting.

Many of the bent glass factories making lamp shades and novelties also do some decorating, but as they are not typical of the decorated glassware industry they have not been included under this head.

The articles decorated are principally table glassware, vases, perfume bottles and other toilet articles. In some factories cutting is also done. The pieces are received "in blank"—that is, without decoration or design of any kind. The design for the gold edges or borders are printed often by hand on a thin paper from copper plates. Some firms have a machine shop and make their own dies, others send them out, and some have their patterns printed outside. The ink used is thick and wax-like and is mixed with an asphaltum varnish or other binder.

After printing, the paper is cut into strips, each containing a section or portion of the design, usually a border. The paper strip is wet with a small brush dipped in water and laid on the plate or other piece to be decorated, to which it sticks fast. The article is dipped in a lye solution and then in plain water and the paper washed off. The design has been transferred to the glass. This is the familiar decalcomania process, long used in china painting.

A line of the black varnish is drawn at the base of the design as a guide, and all parts of the article except the design are coated with hot wax put on with a brush. The piece is now ready for etching and goes to the acid tank. Hydrofluoric acid is used for this work and eats away the parts of the glass which are not protected by the wax coating. As all of the surface has been carefully covered except the lines of the pattern, the acid in a short time cleanly cuts the design into the glass. The pieces are dipped in clear water, then thoroughly washed in hot water with soda or soap to remove the wax. They are thoroughly dried and are ready for the actual painting.

The hot wax, a mixture of beeswax and paraffine, is put on with a small brush. Girls generally do this work. The wax pots are usually in the workroom, either on gas or electric stoves. The smoke from the wax is acrid, disagreeable and irritating to the throat. Wax pots should be provided with exhaust hoods when situated in the workroom. Creosote is sometimes mixed with the wax to form a more effective "acid resist."

The gold used for this work is very carefully prepared. It is pure gold in powdered form mixed with fat oil (an oil distilled from spirits of turpentine) and turpentine.

The gold paint is laid on by hand with a small brush. It is a dull brown in color when put on and does not become brilliant until the article has been fired.

When colors are used they are the ceramic colors used in china painting, and also in stained glass work. These colors are sometimes called mineral or earth colors, as the foundation of some of them is ground quartz, flint, or rock of various kinds. Among the colors are burnt or raw sienna, the umbers and chrome yellow. The colors are put on by hand, and by air brush where the whole surface is to be covered.

A glass flux is mixed with all gold and ceramic colors. The formula for this flux varies in different factories, but they all contain borax, boric acid, potash and some of the lead oxides or carbonates. One firm visited uses red lead, and finds it satisfactory. There are numerous prepared fluxes for sale, but many manufacturers prefer to make their own, and each one has a favorite formula the exact composition of which is not divulged. The use of the flux brings about a complete fusion of the colors and the glass at a much lower temperature than would be required without it.

Paints used for this work must be very fine and smooth. They are mixed in rather small tightly closed porcelain drums, power driven.

Firing is probably the most important step in this industry. Sometimes valuable pieces upon which time and labor have been expended are ruined if the temperature and time of exposure to the heat has not been exactly right. The kilns or ovens are of clay, usually asbestos covered and gas heated. In some factories exhaust systems are necessary to remove excessive heat and gas fumes from these ovens; in others, natural ventilation can be secured through the windows or roof.

Women work at all the operations described, except the acid etching and the firing. Both men and women do the hand decorating in gold, silver and colors. Men are found at the air brush painting.

The glass is cooled gradually after firing, then is washed and the gold or silver given a final hand polishing with water and sand or whiting and a cloth. It is then ready for the showroom.

A cheaper grade of painted glass, principally trays, vases, and ornaments other than tableware, is done with the ordinary lead paints, or coach colors and enamels. This ware is usually not fired but only thoroughly dried. As with the ceramic colors, these also are applied both by hand and by air brush.

Women do most of the hand work, usually a simple design of birds or flowers, and men do the work on the air

[1]New York State Department of Labor, Report of the Industrial Commissioner, 1926.

[2]Factory Inspector, Bureau of Industrial Hygiene.

BENT GLASS KILNS EQUIPPED WITH EXHAUST SYSTEMS FOR REMOVING GASES

VACUUM METHOD USED IN REMOVING DUST CREATED BY BRUSHING OFF PAINT ON STENCILLED GLASS SIGNS.

brushes for the background. Sometimes the article is fired after the background has been put on and then the design is painted on and not fired.

There is a great deal of metal work, plating, polishing, casting of small lead and white metal ornaments, painting, enameling and machine work done in factories of this kind. This work is for mountings, bases or ornaments on the glassware. Some firms make plated silverware in addition to the glass, and two cases of cyanide poisoning were reported as having occurred in the past two years among silver platers. These operations have not been taken up in detail, as they relate to the metal trades.

The principal hazards found in this industry are:

1. Danger of lead poisoning from the large amount of paints handled.
2. Danger from hydrofluoric acid fumes and burns.
3. Danger from turpentine poisoning.

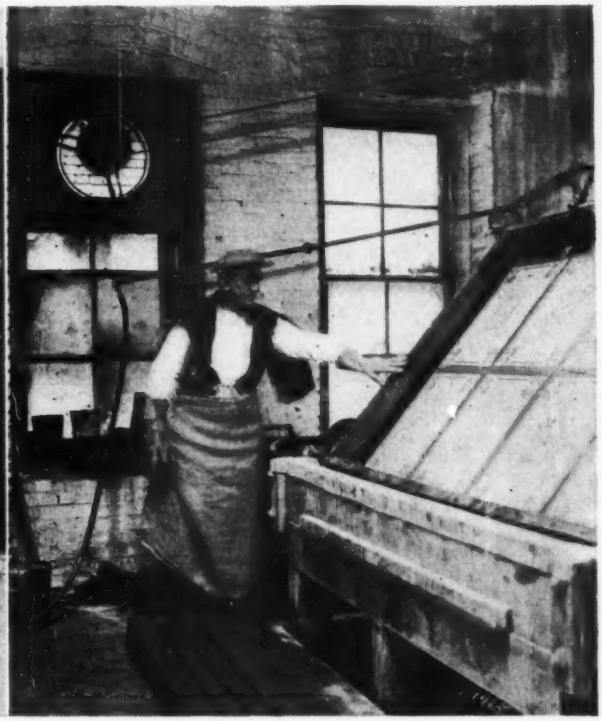
That the lead poisoning hazard is important may be judged from the amount of lead admittedly used. One factory employing less than 100 people uses about 700 pounds of pure white lead per month, besides a large amount of paint, both ceramic and coach colors. In another plant a young man was found painting glass fancy plaques. A large flower pattern had been painted on and allowed to dry. His work was to supply the background. He had a large bucket of white lead mixed with a little umber coloring and oil. He was using a rather large flat brush, with which he worked fast and generously, splashing his hands, clothing and the table as well as the plaques.

He said that he had been working at this job for about a year and a half. Three months ago he became ill with severe headaches, which his physician told him were caused by the work. The doctor gave him some advice about drinking milk, thoroughly washing his hands before eating and other precautions. He looked well and claimed to be entirely free from the headaches at present. This incident shows the careless methods of work by which some people acquire lead poisoning. Careful and neat handling of paint is a cheap and efficient safeguard to health.

The provisions of the law in regard to hot water, soap and individual towels should be strictly observed in this industry. Where at all possible the hot water should be in the washrooms and not just heated in a vessel on a gas stove. Most of the workers and some of the employers seem to be entirely unaware of any hazard in this trade. They often remark: "We only use the regular china painting colors, and some plain paint; nothing poisonous or harmful."

The decorative part of this work is attractive, and the workrooms and general conditions under which this particular operation is done are usually good in comparison to the rest of the plant, the best locations in the factory in regard to light and heat being given to this branch of the work. Perhaps this may be the reason why the women especially are not aware of any danger to health. The small pamphlet on lead poisoning published by the New York State Labor Department, with its instructions as to wearing of overalls, jumpers, caps, etc., applies to the rougher and more dusty operations. In view of the increasing number of workers in this glass industry it is suggested that the small pamphlet be reprinted, and that some specific instructions for glass and china painters be added.

PAINT MIXER ATTACHED TO AIR BRUSH FOR PAINTING GLASS SIGNS



ACID ROOM VENTILATED BY PROPELLOR FAN AND WINDOWS, FOR ETCHING GLASS SIGNS.

A warning that lead and turpentine poisoning can be acquired in decorative work as well as in house painting, and some advice against putting the paint brush in the mouth or to the lips, eating candy or food while at work, and careful washing of hands before eating should be included. The washable smocks now in fashion are very good for women to wear at this work.

Sanitary Conditions

Good housekeeping is very necessary in the decorative glass factory on account of the poisonous materials used. The number of different operations in progress, especially in those plants doing silver and other metal work, make conditions very like the bent glass shops. When metal plating, painting, polishing, soldering, glass cutting and other operations are taking place, often in the same room, order and cleanliness become difficult to maintain. That this can be done is shown by the fact that in three of five factories visited excellent conditions were found.

Art Glass, Stained and Leaded

This is one of the oldest branches of the glass industry. The art of making stained and leaded glass windows, for churches especially, has come down to us from the middle ages.

Leaded glass work is done in two kinds of factories. There are the studios where the highest type of stained glass windows are designed and made for churches and other buildings under the direction of artists and architects. There are also numerous small factories in which are made the cheaper grade of ornamental signs, partitions and transoms, decorative designs for soda fountains and other commercial uses. Although these two classes of work seem far apart, most of the hazards of the processes are the same.

All leaded glass work is done by fitting sections of colored glass of different sizes over a design. The pieces of glass are separated and held in place by flexible lead strips slightly grooved on one side. Lead solder, cement and putty are used finally to make all secure.

In commercial work the glass is bought in sheets of different colors or opalescent, and simply cut into the shapes desired and put together. Few colors are used in this line and little attempt made at fine gradations of shade.

For the making of a stained glass window, painting and firing of the glass are necessary to obtain the effects so much admired, especially in church work, as all the colors and shades cannot be found in glass. Aniline colors and earth or chrome colors (ceramic colors) are in general use, with a small amount of ordinary white lead paint.

Lead in several forms is handled in this trade. There is the pure metallic lead in strip form, of which tons are used yearly, and also lead solder (usually 60 per cent). Cement made from whiting and linseed oil, mixed with litharge and a dryer—Japan or other varnish and 10 per cent white lead putty are also in constant use. For soldering nearly all firms are now using a flux known as "cleanic acid" made from stearine or tallow. Muriatic acid is still used by some and also a rosin soldering paste. Nitric and hydrofluoric acids are used occasionally where frosted or etched effects are needed in addition to the stained glass.

The carrying out of a stained glass design requires much knowledge and technical skill on the part of the worker. The pattern on heavy paper showing where all sections and

stripping belong is laid on a table and the glass fitted on in the proper size, shape and colors. Each workman has a pair of steel pliers with which he snips or "bites" the edges of each piece of glass into exactly the proper shape. This is called "grossing." It is a dusty operation and the glass dust can be seen on work tables and floors. The men have a habit of placing their mouths close to the piece of glass which they are snipping, and blowing the dust away. This is a dangerous habit, as some glass dust is likely to be drawn into the mouth and nose. A foreman who had been for many years in the trade stated that at one time cases of tuberculosis were quite common from this cause.

At the present time much of the glass comes cut more nearly to pattern, so that grossing is not so continuous. The glass is very hard and the steel pliers become worn down from use. In former times a pair of pliers lasted but a few weeks, but since grossing has become less necessary the men say that a pair will last several months.

In using cement and putty, gloves are not usually worn, as exact handling and molding are necessary. This is also true of the strip lead although some men wear one glove while holding a soldering iron, and a knife is sometimes used for putty and cement. The large amount of litharge, red lead and white lead used in putty and cement make lead poisoning a special hazard in this trade. Cementing

ROUGE POLISHING ON FELT WHEELS

is particularly dangerous. Various mixtures are used for this operation, such as litharge and gasoline, whiting, red lead and varnish and others. These ingredients are mixed into a rather thin paste and often rubbed into the seams with bare hands. The paste gets into the skin and under the nails, much more than the putty, which is stiffer and more elastic in texture.

A brush is used for cementing in some places, and at least one workman noted was wearing heavy gloves. Careful scrubbing of the hands with hot water and soap, and particular attention to the nails are absolutely necessary for men at this operation. Where gloves are used, they must be kept clean, or they become a hazard instead of a protection.

This applies also to the handling of the metallic strip lead, which while not so great a hazard as the cementing has its dangers, as cases of plumbism from metallic lead are by no means unknown.

General sanitary conditions in this group as a whole are excellent, but running hot water was found in only about half of the factories visited (116). In many small places there is a gas or electric stove, which can be used to heat water, and in this particular industry it is often so used.

The men employed in this trade are noticeably of a high type in intelligence and cleanliness of appearance. The "floater" found in so many industries is noticeably absent from the leaded glass factory or studio and numbers of men are met with who have been in the trade from 30 to 45 years.

Ventilation

Carbon monoxide poisoning from the large amount of gas used for heating kilns or ovens and soldering irons, and lead poisoning from the discharge of lead oxide into the air of the workroom as a product of combustion of the heating of the soldering iron to which portions of the solder adhere, are two hazards found in this work.

Attention to ventilation and adequate exhaust systems especially for the soldering stoves are the means to counteract these dangers to health. If headaches and dizziness are prevalent among the workers an air test should be made, and an exhaust system provided if carbon monoxide or lead is found in the air.

Accidents

There is no machinery in use in the ordinary leaded glass shop. Acid burns, burns from irons, and cuts from glass happen, but are much less frequent, especially serious cuts, than in the mirror or plate glass factories. Scratches and small cuts on the hands or fingers are common and some first-aid equipment should be in every factory of this kind. Eight small factories were found in which not even a bottle of iodine or a bandage was on hand.

Lunchrooms

The habit of eating at the work bench is especially bad in an industry where so much lead is used, and is forbidden by law. In small places where a lunchroom is not practicable some corner can usually be found away from the soldering and other lead work, if a little thought be taken. Airing the workroom during lunch hour is also a help.

Hazards

The hazards in leaded glass work are:

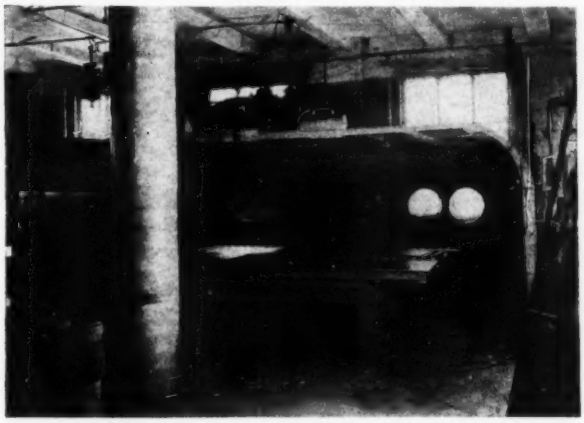
1. Lead poisoning.
2. Carbon monoxide poisoning.
3. Inhalation of glass dust.
4. Cuts, scratches and burns and consequent infections.

General conditions in this industry show most strikingly the good effect of cleanly habits and personal hygiene in the worker. Although lead is handled in large quantities, investigation and questioning of the employers, foremen and workmen in sixteen factories failed to disclose any case of lead poisoning in the past two years. The workers are convinced on the whole that their trade is a healthy one and the predominance of middle-aged and old men would seem to bear them out. This is undoubtedly due to the high standard of cleanliness among these workers and in most of the shops and studios.

Bent Glass

Bent glass is used in making chandeliers, domes and lamp shades. Some kinds of glass signs are also made by this method. The glass, usually colored or opalescent and quite thick, is received in large sheets or sometimes cut into sections of proper size but flat. The sections are bent into the desired shape by means of a Bunsen torch used in a kiln.

The kilns are built of clay, are circular or cylindrical in shape with an arched opening in front. The operator places the section of the glass to be bent on the clay bed of the kiln,



APPARATUS FOR THE RETENTION OF DUST USED IN SAND-BLASTING GLASS

applies the torch and bends the glass into the desired curve by means of a long iron tool.

The heat is intense and the glare in the eyes is very strong. Some workers use a shield or heat plate of asbestos to protect the body from the heat, and yellow or smoked glasses to shield the eyes. Others work with no protection whatever for body, eyes or face.

Lead solder is used in this trade and metal plating is done. In some factories lead castings of small ornaments and metal plating are part of the work. Workers are exposed to hazards from lead, dust from polishing wheels, gas from torches and furnaces, cyanide poisoning and burns and acid poisoning in plating.

Firms in the bent glass business do various kinds of work and differ considerably in the kind of article manufactured. Five factories visited in one city are typical. Of these three make domes and lamp shades only, one also makes or decorates the metal or wooden lamp bases, as well as the shade. One of the remaining two visited makes decorated or painted glass novelties in addition to bent glass, and the other specializes in circular glass signs. It will be seen from this that in the bent glass shop some of the hazards come from the metal and painting operations rather than from the glass work.

In finishing metal lamp bases a priming coat of white lead is used. Over this comes the color or colors desired put on both by air brush and by hand. Many of the lamp bases are rubbed down to give a dull antique finish to gold and polychrome effects. This rubbing is done before the paint is dry with brushes and cloths. In one factory visited several women were employed at this work. They wore heavy gloves and aprons to protect the skin and clothing.

Excellent handling of a paint dust hazard was noted in a sign factory. The signs are painted on white opaque glass discs and are used to advertise gasoline. No cutting or grinding is done at this plant, the blank glass discs being received in proper sizes, about one-fourth of an inch in thickness and perfectly flat. Ceramic colors mixed with a glass flux are used for the painting. Only two or three colors are used and they are applied by air brush. The operators hold a metal stencil over the glass plate while applying the paint, each man at an air brush putting on a different color. When the coloring is completed the plate is placed on a rack until dry.

When thoroughly dry the plates are laid on a table, the stencils are reversed and the paint scrubbed off to show the white background where necessary. This work is done by hand with stiff scrubbing brushes. It is a dusty and dangerous operation, but has been quite effectively safeguarded.

The brushes are circular in shape with an opening in the middle from which projects a hollow metal handle. These are connected to vacuum cleaners under the tables at which the men work. The long flexible tubing of the connection makes the brushes easy to handle, and the paint dust is removed at its source. As the men bend over the tables to do this work the dust if not removed by the suction, would be thrown directly into their faces. When the superfluous paint has been removed the signs are touched up by hand. The glass discs are then put into the furnace, where they are molded on a convex circular revolving plate, which gives them the proper shape.

The diversity of operations necessary in bent glass work render the maintenance of good sanitary conditions very difficult in a small shop. Where a bending forge, one or two soldering furnaces and a small lead pot, buffing wheels and a plating tank with, perhaps, an air brush for paint or lacquer are all being used on one ordinary sized floor in a city loft building of the old type, each hazard of the business is intensified, even though exhaust systems and other safeguards are provided.

This is a typical picture of many small bent glass factories employing from three to twenty people. A noticeable feature in these shops is the lack of protection for the men at the metal plating tanks and the carelessness with which acids, sulphuric and nitric especially, and cyanide are handled. Only one pair of rubber gloves was found in use by the platers and in no factory visited were rubber boots or aprons worn.

In this type of shop the principal hazards are:

1. Lead poisoning from dross disengaged from lead pots and from the use of solder, which if not removed by exhaust systems is scattered as dust in the air of the workroom.
2. Dust from metal polishing and buffing wheels.
3. Acid burns, and fumes. Carbon monoxide from gas used for soldering stoves and bending forges.
4. Heat and glare from the torches and bending furnaces.
5. Exposure to poisoning from lead in paint, wood alcohol, amyl acetate and turpentine used in varnish and shellac.

Recommendations

The most important and necessary safeguard for workers in bent glass shops is strict compliance with the law as to providing soap, hot water and individual towels for workers and frequent and thorough use of them.

2. Rubber gloves and aprons and substantial rubber or leather boots should be worn by all workers at metal plating. Exhaust systems for buffing and polishing wheels and paint and lacquer air brushes are installed in practically all factories doing work of this kind. That exhaust systems are required by law, and that gloves and other protective clothing are not, is very evident, and shows the value of efficient enforcement.

3. Proper ventilation either by natural means or fans to reduce the heat from forges and furnaces and to remove carbon monoxide from the use of gas. An improved type of bending furnace asbestos covered, and asbestos shields for the operator add greatly to the comfort of the worker. Glasses or goggles of dark or amber glass to protect the eyes from glare.

Tariff Hearing on Window Glass

When the first meeting of the public hearing arranged by the United States Tariff Commission for the purpose of obtaining evidence on the comparative costs of production of window glass in this and foreign countries, opened at Washington on the morning of September 11, five members, Commissioners Marvin (Chairman), Brossard, Lowell, Dixon and Clarke and John F. Bethune, secretary, were present.

William L. Monro and W. M. Bonesteel of Pittsburgh appeared for the American Window Glass Company and the Window Glass Manufacturers Association, applicants. R. H. Taylor of the Libbey-Owens Sheet Glass Company appeared for the Window Glass Manufacturers Association. Frank Bastin, Vincennes, Ind., appeared for the Blackford Window Glass Company and the Window Glass Manufacturers Association. Bert W. Miller, Pittsburgh, appeared as President of the Window Glass Cutters and Flatteners Protective Association of America. John R. Rafter, New York, appeared for Belgian and Czecho-Slovakian manufacturers. A. H. Schottland, New York, appeared for the Comptoir General Belge.

A preliminary statement[1] had been prepared by the Commission containing a large amount of data on the production of window glass in this country and abroad.

After disposing of the necessary preliminaries, Chairman Marvin pointed out that the statute under which the hearing was being held provided for a public hearing at which interested parties may be present, produce evidence and be heard. He then called for witnesses in favor of the applicants, the American window glass manufacturers, who maintain that they cannot under the present tariff on window glass meet foreign competition, particularly that of Belgium.

William L. Monro responded, was sworn, and proceeded to first explain that the elements entering into the manufacture of window glass are practically identical with those that are employed in the making of plate glass, with which the Commission is no doubt very familiar, having had many sessions with the plate glass people.

He also took up the question of trade names such as "photographic glass," classifications for the different thicknesses of window glass and described their meanings and significances and then began an interesting and comprehensive account of present conditions throughout the window glass industry as he sees them and explained the causes behind those conditions and reasons why a higher tariff on window glass is needed. Abstracts covering most of its important and interesting points are presented below.

At the conclusion of his statement Mr. Monro was cross questioned on many phases of the subjects he had just covered. He was asked by Mr. Rafter regarding payment of royalties by the American Window Glass Company to the American Window Glass Machine Company, and about the highest percentage of the total production of domestic window glass reached by the American Window Glass Company at any time during its existence, but would not state it. He was questioned as to whether the introduction of the Colburn process used by the Libbey-Owens Sheet Glass Company had any effect on the American Window Glass Company's production and replied that the former took in a large part of the market that was formerly held exclusively by his company. He told of the company's plants at Belle Vernon, Ohio, where one of the two furnaces had been put in operation about the middle of February, 1928, with one of the furnaces serving ten Fourcault machines which had superseded eight cylinder machines, and one experimental machine. The other tank was left unchanged and is still equipped with cylinder machines. He stated that the factory had not been using the cylinder machines for some years because they could draw the cylinders to only 370 inches long while the modern installations draw them 518 inches long, which was more profitable.

Mr. Rafter then asked whether Mr. Monro could cite the case of any company employing the Fourcault process or Libbey-Owens process which adopted at a later time the cylinder machine process. The answer was negative. Questioned on the subject Mr. Monro said that all of the glass made in England by the largest producer, Pilkington Bros., is made with American window glass machines.

[1] For extensive abstracts see THE GLASS INDUSTRY, August, 1928.

Archibald H. Schottland was called as a witness. He is manager for Benjamin Schottland, New York, who is United States agent for the Comptoir General Belge. Asked by Mr. Rafter regarding problem No. 2 for discussion in the Preliminary Statement, "Were the conditions of production in the United States for the year 1926 normal conditions so that the costs obtained in the United States for that year were representative costs and suitable for purposes of comparison?" Mr. Schottland stated that he was in no position to speak authoritatively about the conditions prevailing in the window glass business in 1926, but he had an opinion about the matter and that Mr. Mazzarovich directed his attention to changed conditions since 1926, which made him feel inclined to believe that the year was not quite normal. There was a 15 per cent average decline in wages. He noted that the Libbey-Owens process seemed to be increasing their production from year to year, which he thought showed that they are becoming more and more efficient with their process and able to produce more. Also that the Fourcault process is also increasing. He also stated that the Fourcault process no longer has to pay royalties to anyone in the United States, so their costs are somewhat lower.

He said the imported glass could not be sold far inland on account of freight rates. The question of selling and distributing the Belgian glass was gone into and the methods used were outlined. Mr. Schottland claimed that figures presented showed that the domestic manufacture has at least 60 per cent the total consumption of window glass without any foreign competition whatever. The remaining 40 per cent of domestic consumption is divided, 72 per cent to the American manufacturers and 28 per cent to foreign glass. He stated that the average time of delivery for foreign glass is two months or a little over. He denied that the Comptoir accepted small orders for five or ten boxes.

Speaking of selling expense, Mr. Monro said "I want to say this for that item of bad debts. That I do not believe there ever was any industry in which the losses from manufacturers to dealers through bad debts was ever as small as it is in the window glass business. We did business for a number of years aggregating from $15,000,000 to $20,000,000 and took insurance on it for bad debts. The insurance policy I think cost somewhere about $4,000 and finally we dropped it because we did not have over a period of six or seven years, as I recall the figure, as much as 53/1000 of one per cent—practically negligible." He described the kind of advertising done by the company and said that it was obliged to carry fifteen promotion men.

A point brought out by Mr. Monro was that the Fourcault process produces cheaper glass than the cylinder process because it is operated seven days a week.

Mr. Bonesteel, secretary and treasurer of the American Window Glass Company, and formerly ex-auditor, was sworn in and the afternoon was occupied in discussing information which he gave relating to costs and depreciation charged up in the year of 1926, as having a bearing upon the total production costs for that year. Incidentally it was brought out that cylinder machines were first installed by the company in 1903.

Mr. Rafter, representing the interests opposed to the applicants, noted that though the order for investigation provided for inquiry into the cost of production of cylinder, crown and sheet glass no data appeared in the Preliminary Statement with respect to crown glass, the figures being limited to cylinder sheet glass. Inquiry at the office of the appraiser of the port of New York elicited information that crown glass is being imported into this country to the extent of about $150,000 worth a year. He then took up the question of the so-called crystal sheet glass and stated that Mr. Monro's testimony had made it perfectly plain that this glass is a separate and distinct variety. He said he would endeavor to prove that all of that variety of window glass is imported from Czecho-Slovakia.

Lucien Larsimont, of the Cronfestu Works, a member of the Comptoir, was called as a witness and sworn. He explained the methods by which the production of glass in Belgium in 1926 was figured and that the Fourcault glass production in Belgium for 1926 was 218,756,000 square feet. 59% of the total production in Belgium for that year was by hand cylinder processes. The methods of conversion from Belgian francs to dollars was discussed.

M. Mazzarovich representing the Vitrea Company, Inc. of New York who import Czecho-Slovakian glass including the formerly so-called demiplate, also testified. The hearing finally closed on September 21. Commissioner Marvin suggested that the interested parties exchange briefs on October 4 and set October 15 for the filing of final briefs.

Abstracts from Address of W. L. Monro

Now, I have studied over the report by the experts of the Commission, and I have given it very careful, analytical study, and I want to say to you gentlemen that no more complete, thorough, accurate or comprehensive document has ever been brought to my attention, that has been gotten out by anyone that was not thoroughly familiar with all the details of the industry, and I do not believe that it is possible for anyone to get up a report that will surpass the report that has been made to your Commission by your experts in this matter. We have checked it back and forth. Our auditor has gone over it, and the auditor for one of the other large companies has also gone over it most carefully. We cannot pick a flaw or injustice in its statement of the situation. The figures must have been taken from books that were properly kept, or, if not properly kept, the experts have had the ability to rearrange the figures so that the results of their work showed exactly the points that this Commission has got to be advised upon before approaching a decision as to the present sufficiency of the tariff.

In going over this report the experts have contributed a great deal to the history of the industry, their exposition of the change that has come over the process of making window glass. I assume that you gentlemen have been so busy that you have not had time to go over this, and I just want, for your information, to tell you that the report points out that for centuries no improvement has been made in the process of manufacturing window glass until the American Window Glass Company took up an invention of one John Lubbers, an ordinary flattener, who was in its employ, who conceived the idea of making window glass mechanically. It was such an unheard of thing that people would not take any stock in it, but, interesting some of the officials and bankers of the American Window Glass Company, he went ahead and developed this process of blowing glass by machines.

In the hand-blowing process, the process was controlled in Europe for centuries by guilds and by labor organizations who prescribed their working rules and the number of cylinders that could be blown in an hour, and in a given term. It was always a close organization, and it remained so in this country; but, just to show the difference, when the hand-blowing process was in use, the ordinary hand-blower would make, first, 48 100-foot or 96 50-foot boxes of single strength glass per week, and then as

the competition of the machine came on it got up to 60 100-foot or 120 50-foot boxes. They got up to 120 50-foot boxes of single strength during the week. One blower with one of our machines would make ten times that and more than that, and of course it brought in some other kinds of labor.

The ordinary hand-blowing cylinder, when flattened out into a sheet, averages 40 by 60. The cylinder that we use makes a sheet of glass about 100 inches by 518 inches long. Of course, we do not make the sheet in that way, but that is the size cylinder that we make, that would make the sheet.

I have been asked by my associates and advisers, what points in this report I thought the attention of the Commission should be directed to, and my answer to that was "simply to the pages in the report that showed the average Belgian cost of production and the average domestic cost of production." Because, after all, our interest in the tariff is not for purposes of revenue. It is for purposes of competition, and the price at which they can lay down their glass at the seaboard is the amount that limits us, within a few per cent, of the price that we can obtain for our product, because the seaboard points or rather the ports of entry are the consuming point.

The question may be raised, "Well, why should you not take the points of average consumption?" I say "No." The proper rule to follow is, your competition takes place at the point of consumption, and you should have a tariff to protect you where you have competition instead of some place where you have no competition.

I will point out how it works out.

Without figures, but from an experience in merchandising a large quantity of glass—and I will say this to you, gentlemen, so that you will know—I do not say it boastingly, but so that you will know the extent of the experience that we have had—up to two years ago the American Window Glass Company produced in excess of one-third of all the glass that was produced in this country. Consequently, we had to market that, and in marketing that large volume of glass we were brought face to face with all sorts of conditions, among which was your export condition. And I say to you gentlemen that the imports of ordinary window glass bring the competition right at the port of entry, because the ports of entry happen to be the largest consuming points and the principal points of entry along the Atlantic seaboard are Boston, New York, Philadelphia and smaller amounts further along. Along the Pacific coast seaboard you have San Francisco, Los Angeles, Portland and Seattle. All of those cities are great consuming points. They are what we call great jobbing centers, because they are sash and door mills. They are the points, consequently, where the glass is used, and that is where the competition is.

I will venture to say that not 10 per cent of all the glass that comes into the port of New York, which represents by long odds the greatest amount brought into any part of this country—not 10 per cent of that glass goes outside of the ordinary trucking distance from the dealer's warehouses in New York.

Now, then, as far as this photograph glass is concerned, you have a little different situation. The points of consumption there are St. Louis and Rochester. That is because the Eastman Kodak Company has its big factory at Rochester, and until they perfected films for photographic use, that is, for commercial photographic use as well as for pleasure, and dry plate, the Eastman Kodak company used more photographic glass than all the other dry plate makers in this country, and they still use a substantial quantity of dry plate at Rochester, and the imports of dry plate are consumed right there in Rochester

Now the next point is St. Louis. At St. Louis there is the Hammer Dry Plate Company and the Kramer Dry Plate Company, and I think one or two other small ones, but those represent practically all the important dry plate companies in the United States. So that when you go over the report and see the glass that came into St. Louis and the glass that came into Rochester, please bear in mind that that is all dry plate.

We have two of the three jobbers in Rochester, N. Y., in the room here now, who will tell you that there is practically no window glass imported into Rochester.

When you go outside of the ports of entry the amount of glass that is shipped inland to Cleveland, Toledo, Chicago and points like that is absolutely negligible. The same thing is true on the Pacific coast. They cannot ship glass in on the Pacific coast if they wanted to, on account of their freight rates, for one thing, but the big sash houses out on the coast are all around Los Angeles, San Francisco, Seattle and Portland. Those are the places where the glass is actually used and put into glazed sash and distributed all throughout the West.

So that I say that as a principle, we firmly believe that the tariff must be based on the competition—where the competition is and not where it is not.

There is one thing in the report: the experts have determined the geographical center of consumption as somewhere around Indianapolis. Well, if you framed a tariff based on having a tariff that just met the American price at Indianapolis, then for every mile you went towards the seaboard the importer would have the advantage over you, and instead of importing as he did in 1927, between one-sixth and one-seventh of all the glass used in this country, he would have 33 to 40 per cent of your market. If you followed that rule and had your tariff constructed on the basis that he could just break even with you at Indianapolis, all of this Eastern market, which is the big market, would be handed over to him.

Now, gentlemen, getting back to the very important facts in this report, I am going to take a little credit to ourselves by calling your attention to our Schedule A as an evidence of our desire to be fair in the matter.

In Schedule A I did not attempt to take Belgian costs, but we took the Belgian selling prices, and Belgian selling prices at the time this petition was filed, in April, 1927, were 10 per cent below the Belgian list.

Window glass, gentlemen, for your information, is sold on a list. I have here a copy of the list, and we will file with our brief copies of it for your information.

That list classifies glass according to what we call "brackets"; the 25-inch bracket, the 34-inch bracket, the 40-inch bracket, the 50-inch bracket, and it takes up those arbitrary divisions.

What do we mean by the word "bracket"? Well, we mean glass that the united inches will not exceed 25. If it is 14 by 11, that is the type of the 25-inch bracket, or any size which with the length added to the width, produces the limit of the bracket. That is what we mean. That goes into 25.

Then, if it is 34, it is 16 by 18. Anything between 11 by 14 and 16 by 18 goes in the 34-inch bracket.

By the way, the Belgians do not have a 34-inch bracket. They jump from 25 to 40. Then from 34 you go to 40, in the same way. Anything that runs over 40 and not over the next bracket number goes into that next bracket.

So that when they talk to you about brackets, it means the bracket embracing the united inches of the length and width, added together. So that after you get that feature of the thing, then you have your different qualities.

Now, there are in this country five different qualities. First, there is the AA or first quality. Then there is A, or second quality. Then there is B, or third quality; then there is fourth quality and C or fifth quality.

Now, due to the lack of salability of your glass, if you tell a man you are selling him third quality, we do not stress the term, "third quality," very much. We prefer to call it "B." The jobbers find they can market glass much more readily if we brand it "B" than if we brand it "3d," or they can sell "A" quality a good deal better than if we mark it "second."

There is a reason for it in this: This so-called first quality or AA quality, there is an infinitesimal amount of that producible in the United States. It does not run over 3 per cent and seldom that. So that in the ordinary commercial business you are bound to disregard the first quality glass, because the amount is so small and it is so difficult to get. I think that is one thing that affects it.

No manufacturer, maintaining a high standard of grading for his A quality, can possibly get very much glass better than his A. If he takes the very best of it out, then he will not get A glass. He will have to put the rest of it down into B. So that I do not regard the first quality or AA quality as being a practical commercial quality.

Chairman Marvin: Is photo glass of the first quality glass that you have just described?

Mr. Munro: Not necessarily. There are certain defects in photographic glass that we could not put into AA quality, and photograph glass is sold in firsts, however. Photograph glass is never known under AA and B. It is also sold at first, second and rejects.

But, in first quality photo, we put, for instance, lines or faint threads in the glass—treating streaks or heating streaks or whatever you choose to call them; what we call lines or faint marks

in the glass that will not interfere with the photograph. The photograph manufacturer does not look at that with reference to light lines, but we could not sell picture glass with those kind of lines in it. Nor could we sell a jobber glass with those kind of lines, as first quality, that was going into a house, because they would show up. But then there are certain other defects that the photographic glass will not stand, that the other glass will. For instance, very faint burns on window glass will pass. If it is too near the center of the light, very often it may go as first quality. But if you have the slightest burn on a photo glass it cannot go into first, because it produces a pimpled appearance, and it prevents you taking a smooth picture.

In the same way, you might have in a first quality photo what we call a little seed. It is a very faint air bubble. In the hand-blown process they are round and slightly elongated. In the machines they are elongated more. In a photo they will not take that in the first quality glass, but in the ordinary window glass if it is very small, they will take it.

Now, the reason I am stressing this photo glass is that I have a rather sad story of experience on this photograph glass.

We went into this photograph glass business a couple of years before the war and produced glass and sold sheets to a concern who had a cutting establishment in Belgium. Nobody had ever attempted it on a commercial scale and kept it up until we took it up. We finally made a success of it, and this concern went good for a couple of years, when we took over the business ourselves. We were engaged in making a limited amount of photographic glass which we were selling in this country, and we had to break our way into the trade because we were all set on the foreign glass.

We were improving right along, and then the war came. That gave us the photographic business of the United States and also the rest of the world. Nobody could get any photograph glass except from us. We found that we had to extend that plant. For example, with our cylinder process we had eight machines at that plant. Ordinarily, seven flattening ovens would have taken care of those eight machines, but when we threw those machines on the photograph glass we had to put up new flattening houses, and put in seven more ovens, so that we had fourteen flattening ovens there.

Then, while we had room for the ordinary cutters cutting this glass, yet, photo cutting involves so much detail and there are so many small sizes that we had to put up separate rooms, and at one time we had 650 people working there. When the war broke out the Government came to us to see where they could get glass for eye pieces for gas masks, which they laminated. Those circles were about 2¼ inches. They tried everybody, but nobody told them about us, and finally they came to us. We were the only source of supply that the allies had for glass for gas masks during the war, at our Monongahela factory, and during that time we produced 27,000,000 of them.

It might be interesting to you to know that we could not get labor to cut them until we interested the local division of the Red Cross, and men, women and children came down to our factory and worked in shifts for months and months learning to cut. We stood all the expenses of teaching them andd wasting the glass, but they got out 27,000,000 of them that were approved by the Government for gas masks.

Now, if we had not gone into that photo business the Government would have had no place to go. They would have had to use the single eye piece which they started with, but there were so many men cut with the breaking of the glass that they found they had to go to laminating them, and the sad story that I wanted to tell the Commission is that your present tariff has closed that factory. We have not turned a wheel at that factory since the latter part of 1926. We cannot sell photograph glass in competition with the Belgians, with the tariff protection that we have got.

Before we shut off photograph glass we were getting more for 3rd quality window glass than what the buyers of photograph glass could afford to pay us in this country.

So, we have considerably over a million dollars invested in a plant that we built especially to handle the photographic glass business, and after the Belgians found their way around, after the war was over, we had to stop. We did not make any photograph glass in 1925 or 1926. We ran it on window glass as long as we could, and the market was breaking, but in 1926 we stopped. They finished us, I think, about the middle of 1925, as far as photograph glass is concerned. That plant has not turned a wheel since the fall of 1926. So that in bringing up this photograph glass proposition, I say it is rather a sore spot with the company that it went ahead and developed the business, and then arrived at a condition under which they could no longer compete with the prices that the Belgian manufacturers were able to place on glass at both St. Louis and Rochester, in spite of the fact that we could get on an average about 50 cents a case more as a preferential for our glass than what the Begians got, but the price was still higher than the Belgians.

There were two reasons why we got the preferential. First of all, the foreign manufacturer generally required a large sized order, and they ordered it 5,000 cases at a time or 10,000, or they have contracted for 30,000, and with us they were able to order a couple of cars and get them within a couple of weeks. When they place their order in the fall, as a general rule, the Belgians took a price that carried through the season. They placed those orders on that basis, but we never did business that way. Consequently we got a preference, due to the fact that they did not have to place a large order, and then perhaps find that the market somewhere else had broken and they were able to get their glass quickly. So, I brought that up for that reason, because that hurt especially in that line.

As I said before, I want to call attention to the fact that taking the Belgian selling price, not their cost of production, which was 10 per cent below their list, and which I wish to point out to the Commission is 10 per cent below the average selling price as reported by the Commission's experts, the Commission's experts got these figures, no doubt, from representative men over there at a certain time—but, the Belgians have not been maintaining the list, and were selling from straight list to list less 17½ on 4th quality. The other discounts changed.

Taking the Belgian list, less 10, which was the selling price, than the freight, Antwerp to New York, which is 20 cents a hundred, and just right there let me point out that the freight rate from the nearest window glass producing factory in the United States to New York is 34 cents per hundred pounds—there is 14 cents per hundred pounds advantage on the ocean freight.

Taking that 20 cents per hundred pounds, then we give them credit for the fact that the imported glass bears a larger expense for cartage from the customs than it does if shipped by rail, and that is averaged at ten cents a box; so that we gave them the benefit of the additional charge for customs. Then, add on your duty, and you have a total landed price, averaging all products together, which is just the manufacturer's rough and ready way of doing it, in the percentages of the qualities that are usually imported, we get the Belgian cost at $2,286, laid down in New York.

Now, before preparing this petition I sent letters and had letters sent out by different people that were in closer touch with our competitors than some that I was in touch with, and asked them to give me the average of those costs by different groups.

I took our own costs and took these figures that came in, and we averaged them up and I made an average of the domestic cost of production, f.o.b. factory, $2.456.

It might interest the Commission to know that on page 82 of the Commission's experts' report, the experts have reported that the weighted average, with imputed interest included, was $2.488.

While I am on this, let me call the Commission's attention to what I think is the meat of this entire cocoanut.

Page 82 shows the cost of production by departments, for plants grouped according to process of manufacture; that the weighted average for each group of plants and for all plants combined, per box, containing 50 square feet of single strength thickness—the total, without imputed interest, of all plants was $2.333; and the imputed interest averaged 15½ cents, making a total with interest $32.488; while, with our rough and ready method of calculating, as set forth in the petition, it was $2.456.

Now, then, as against that let me quote to the Commission some totals for the Belgian factory—totals without imputed interest, on the Belgian costs $1.053, against the United States $2.333; and with imputed interest added, the total Belgian cost for all factories costed was $1.102 as against $2.488.

I wonder whether I need to say more to the Commission than to call your attention to these facts—$1.102 against $2.488.

Here we have a tariff, and the thoroughgoing experts of the Commission have reduced that tariff to an ad valorem, according to brackets, and, as I roughly calculate it, it is somewhere about 60 per cent or a little less than that. Add your 60 per cent to it and you will still see that you are far short of the protection the industry needs in this country, or the protection which this Commission has a right to recommend the President to give, namely, 50 per cent increase.

Now, I do not know what is moving in the minds of the Commission as to the point that appeals strongest to them, but to the manufacturer, he takes the situation as he finds it. He must not only manufacture; he must sell. When he sells he comes into competition with the product of his competitor, and he comes into competition with them in this case particularly, except for this infinitesimal amount, at the port of entry, and as far as we are concerned, we cannot see why we should not have protection at the point where we have the competition.

There are various reasons for that. It takes a long time to educate people into the handling of a foreign made article like window glass, but for years and years there has been a certain zone along the Atlantic seaboard and along the Pacific seaboard where people have been educated up to the methods of buying, and to use this foreign-made glass.

The usual difficulties of placing an order and looking after the thing and paying your money in advance so discouraged the ordinary American consumer that he would not bother with the thing, but the Belgians, with very commendable merchandising zeal, have now worked it out that you can go to a broker in San Francisco and he will quote you Belgian glass, for 10 boxes, laid down on the dock at San Francisco or Los Angeles at the same price he will quote a big dealer 10,000 boxes. But, in this country we have a different system of doing business. The manufacturers in this country do not sell in less than carload lots, and we are forced to meet the competition of the importers who can buy, if they choose, or their customers—our jobber's customers—can buy 10 or 15 or 20 boxes just as cheap as the jobber can buy 5,000 boxes and distribute to him. So that that makes quite a difference.

But, I am inclined to think that I will waste the time of the Commission if I stress anything more than the fact that the Commission's own experts, after nearly 9 months of thorough work both in this country and abroad, have found that the Belgian cost of production is $1.102 and the domestic cost of production is $2.488.

Now, there was a question raised by the experts as to whether selling costs should be added.

Selling cost is really not a part of manufacturing cost, but if you are going to consider transportation, you would have to consider selling. One goes hand in hand with the other, and if I may again quote to you the domestic selling expense is 5.9 cents a box while the Belgian selling expense is 1-10 of a cent a box on the average.

So that that brings me around now to this other question which the Commission wished to hear:

First, "The data secured by the Commission include cost of production by the hand-cyclinder process for two plants in the United States and three in Belgium. Should these costs be included in the final cost comparison?"

I say "Yes, gentlemen," and I do it knowingly for the reason that the costs of the hand blowing factories in Belgium are very much lower than the hand costs in the United States. In view of the fact that Belgium continues to make a very large quantity of glass with the hand blowing process, I think it would be most proper that it should be included. But if the Commission undertook to take out both the hand blowing costs in Belgium and the hand-blowing costs in the United States, on the ground that the hand-blowing process was practically extinct here, you would not change the totals in any appreciable amount.

Therefore, I say it is just as well to leave them in, because you would only vary the totals a fraction of a cent.

Then the next question is:

"Were the conditions of production in the United States for the year 1928 normal conditions so that the costs obtained in the United States for that year are representative costs and suitable for purposes of comparison?"

I say "unquestionably." The Commission's experts have given you the figures, and 1926 was not as large a production as the preceding year, and it was more than 1927. It fell off in 1927, and that falling off in 1927 was the result of two things: First, an increase of 9½ per cent in the amount of Belgian glass imported into this country, and secondly, in the amount of building permits in this country compared to 1926.

I was supplied this morning with some information collected by experts since the report was prepared, and it shows just what we had figured, namely, that there was a falling off generally in the building business in the United States of about 10 per cent, while the Belgian imports increased from 82,000,000 pounds to something like 84,000,000, or, figured out in percentage, about 9½ per cent.

So that I think every manufacturer in this country will agree that conditions have been normal in 1926 and 1927.

The next question is: "Were the conditions of production in Belgium from January, 1926, to July, 1927, normal conditions so that the costs as obtained in Belgium for individual companies within that period in francs are representative costs in francs?"

From anything that we could see, from figures based on the Belgian production as compared with their capacity, there is no reason why 1926 should not be considered as a fair representative year for Belgium. Certainly no information has ever been put in our possession that would justify any other conclusion.

The Belgians, after the war, came into the window glass game, and I went over there, and they were taking advantage of their low money. They were making the most unheard of profits in the window glass industry, and a friend of mine who had been negotiating with us for our machines but who did not dare to put them in on account of incurring the opposition of the labor organizations over there, said to me, "Mr. Munro, our profits are immoral." That is the way he described the profits that the glass manufacturers made in Belgium immediately after they got going after the war, and the profits of those Belgian companies mounted to enormous figures.

Supposing the foreigners could put us out of business with their system of conventions and associations, with no anti-trust laws, that are able to get together in a room and agree on the production and on the price at which the product shall be sold, and punish the man who does not live up to it—where is the manufacturer going to be in this country with that kind of competition, with the Sherman Act and the attorney general's department prodding them with a spear from behind. Once they got us in a weakened condition, they could make this so-called country of nothing but rich people pay the price. That is the Utopia for the foreign manufacturer.

They have given you figures here as to the amount of window glass imported in this country, and it has increased step by step until, as I say, in 1927 it represented between 1-6th and 1-7th of all the glass produced in this country; between 1-6th and 1-7th as much glass as we produced they put in here. Now, we have got in this country some two million idle people. Don't we need the additional production to give them the work that that would mean? That increase alone would give employment to over a thousand men in this country for 46 weeks during the year.

Then, as one member of the Commission said to me—Mr. Dennis, I think it was—"Please tell me why you cannot compete?" I told Mr. Dennis: "Mr. Dennis, we have figures showing this: Belgium is paying 20 francs a day for common labor, and taking the franc as worth"—I took it as worth 2.8 cents then—"that was 56 cents a day for eight hours of common labor." At that time the lowest rate of wages paid in our factories to any employees was 40 cents an hour. Now, go before a manufacturer with that proposition—on the one hand 7 cents an hour; on the other with 40 cents an hour—and he will tell you that you cannot stay in business. It does not need any argument to prove that.

Well, you may say, that is common labor, but you use semi-skilled and skilled labor. Yes, but you will find this to be the case, that the rates for semi-skilled and skilled labor always bear a certain ratio to the wages paid common labor, because when your common labor goes up, the semi-skilled goes with them; when your common labor goes down, the other goes down.

Now, then, take the figures there, and then ask yourselves: "Why is it they can make this glass?" Well, you have got seven cents an hour labor against 40 cents an hour labor.

Take cutters, for example. We all employ cutters no matter what process we use in making the glass. In Belgium a cutter earns about $28 a month. That is high. They do not all earn the same. He earns about $28 a month we will say. Our cutters earn on an average about $48 a week, and yet our factories are partly manned with Belgian cutters, and let me say this to you, gentlemen: There are no more industrious nor skillful workers that come to this country and work in our glass factories than the Belgians. When a Belgian comes to this country he can hold his own with any labor we have, so that you cannot base it on inferiority of labor.

Take another thing: You may say: "Well, what about the costs of your raw materials?" Well, just take those four costs that I have quoted you. Sand in this country averages the American manufacturer—and that is the item of which he uses the largest amount—the American manufacturer pays $3.84. The Belgian manufacturer pays 66 cents. Soda ash or carbonate of

soda: The American manufacturers' cost was an average of 29.29; the Belgians' 15.57. In other words, he paid about half. Salt cake: The American manufacturers' was 22.84; Belgians' 11.08, or about half. Limestone: American manufacturers was 7.18; the Belgian 1.09, or about 1-7th.

Then you may say: "Oh, well, but his coal is higher." His coal is higher. Yes, his coal is higher, provided he don't use natural gas at 40, 50 and 60 cents a thousand, as some of the factories are obliged to do in limited amounts. However, the fact remains that when you take the item of power and heat, which includes all sources of power and heat used around the factory, and includes also the labor in connection with it, because even if you have cheap coal or dear coal and you have cheap labor to put it into the producers, because all the fuel used in the glass factories in Europe is producer gas, and that is made through the ordinary producer system. Now, then, if you have 7 cents an hour feeding producers and that class of labor around your plant, and there is a great deal of labor connected with the operation of your producers, taking away your ashes, cleaning out Saturday nights and Sundays, and different operations of that kind, when you take that into consideration, the Commission's report shows that the Belgian item of power and heat is about one-third more than the domestic.

Now, gentlemen, I could go on and bring up other departments of this matter, but I only desire to hit the high spots, and let the Commission, when they come into the thing, verify the statements I have made.

The commission have also asked a question: "By which of the following methods of conversion are the Belgian costs in francs most suitably expressed in terms of American money for purposes of comparison with the United States costs? (a) Method No. 1, the cost in francs of each company for the period costed converted at the average rate of exchange for that period";

We certainly think that is the basis that should be followed, for the reason that they are selling their glass in competition with us and do arrive at the cost of the glass on the basis of what the francs they lay out are worth, translated into American dollars.

Now, it may be said: Well, supposing now they bought materials before and had to pay 20 francs and took that into their operating cost? All well and good. They kept their costs in francs and certainly any contracts that they may have made before the beginning of that year, whether they were beneficial or otherwise, all went into those cost sheets in francs, and to arrive at a uniform basis for those costs I think you are bound to take the average of what those costs were for basis of our comparison converted into our dollar at the then prevailing rate. So that we think is the proper way and method of doing it.

But if you feel that you wanted to take the other method, the cost in francs of each company for the period costed converted at the average rate of exchange for that period and the six months preceding, why the six months? Why four months? Why three months? Why two months? But if you want to do that, give it to them. Add that to their cost of production and you will still come to the conclusion we have not got the protection we are entitled to under the intention of this clause of the act.

The next question comes up—I do not think the question of transportation is a factor, but it is incidentally involved: What are the principal wholesale markets in the United States for domestic window glass? Let me read them over to you: Providence, Boston, New York, Newark, Albany, Philadelphia, Baltimore, Washington, Richmond, Norfolk, New Orleans. Those are all practically what you might call coast points with the exception of Albany, Rochester, New York, Syracuse, New York, Buffalo, Pittsburgh, Cleveland, Cincinnati, Dayton, Toledo, Detroit, Grand Rapids, Louisville Indianapolis, St. Louis, Chicago, Minneapolis, Milwaukee, Davenport, Clinton, Kansas City, Memphis, Omaha, Denver, Dallas, Salt Lake City, San Francisco, Los Angeles, Portland and Seattle. Now, I have missed some other points that use considerable glass, but these are the more important and they comprise, if my arithmetic is correct, about 39 points.

Now, then, you may say: "What are the principal wholesale markets in the United States for window glass imported from Belgium and to what extent do the statistics of the entries of Belgian glass at the different ports of entry indicate its actual distribution within the United States?

Answering that, I will say that the principal points of entry are Boston, New York, Philadelphia, Rochester, St. Louis, San Francisco, Los Angeles, Portland and Seattle. There are some others that are small. Answering the second part: "To what extent do the statistics of the entries of Belgian glass at the different ports of entry indicate its actual distribution within the United States?" I get back to the statement that I made before that practically all of this glass is distributed in the eastern seaboard within trucking distance of the ports of entry. In Rochester and St. Louis it is all processed. It is shipped out not in the original containers, but it is all processed; it is all unpacked; it is washed; it is coated; then goes out, not in boxes like we ship window glass, but in the package you are accustomed to buying the photo plates in. The same is true also in St. Louis. But practically every bit of this glass, with a negligible percentage, is used directly at the ports of entry. That is our point of competition.

The next question: Should the final cost comparison for purpos of section 315 of the tariff act of 1922 include selling expenses? If you are going to include transportation costs, I should say you must include selling expense and if you include selling expense why you will see from the tables I have read to you that our selling expense is about 5.9 cent and the Belgian selling expense is 1-10th of a cent.

Another thing let me direct your attention to: The experts of the Commission were very fair to these Belgians. They have given you Belgian costs FOB Antwerp. The average Belgian has 2¾ cents to 3 cents lower productive cost at his factory. It costs him from 2¾ cents to 3 cents a box to ship it by the canal—I think most of it goes from Charlero up to Antwerp that way—and to load it on the steamer, but the experts for the Commission have leaned backward and added that to the Belgian costs, which makes the Belgian costs appear that much higher.

Now, if selling expenses are included should they cover the costs incurred in distributing the commodities in wholesale quantities, regardless of who incurs the expenses? My answer is, Yes.

Then the eighth question: Under the tariff act of 1922, window glass is dutiable at different specific rates per pound based upon superficial area. In this investigation, for both the United States and Belgium, an average cost of production per pound, irrespective of size and quality, was determined. Discussion is invited as to what methods should be used if those average costs are translated into specific costs for each of the tariff brackets.

My answer to that, gentlemen, is that I hope you will do nothing to change the present method of computing the duties. If you do so you will invite questions as to the power of the Commission to do anything but to increase the duty as the duty now stands or recommend increase in the duty as the duty now stands bracket by bracket. Once you undertake to revise those schedules of duties that Congress has fixed upon, you invite the question of the power of the Commission, and gentlemen, the condition of the industry in this country does not warrant the delay and the risk which that would involve. We have had to cut our wages; we have had to cut them; we have cut part of them twice; we have cut as low as 30 per cent on some of our labor in order to keep from utterly passing out of the business. There has been no money made in the manufacturing business, with the exception, as I say, of one or two factories, and this proposition is not an industry that is asking you to maintain it on a profitable basis; it is an industry that is coming to you for help to bolster it up and to put it in a position where it can put itself on a profitable basis because the price at New York, our port of competition—the price at any port of entry—determines the price at Chicago, with the exception we equalize the freight with either Pittsburgh, Columbus or Kansas City on those shipments, but the jobber in his warehouse in Chicago is getting his glass at practically the same price that the jobber at the port of entry, the place of competition in New York, can. So that the competition drags down the whole level for all of us.

Manganese. Issued by J. Carson Adkerson, president, American Manganese Producers Association, Washington, D. C. An address by the President of the Association was made at Butte, Mont., March 17, 1928, who discussed the world situation in manganese, the production of ore in the United States and especially the development of this mineral in Montana, the leading producing State.

Sherman J. Lowell of New York, it was announced on September 6, has been reappointed by President Coolidge for a twelve year term as a member of the United States Tariff Commission.

The Glass Industry

ESTABLISHED 1920

The First Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials, and Glass Factory Equipment and Operation

Published Monthly

Copyrighted, 1928, by

GLASS INDUSTRY PUBLISHING COMPANY, INC.
50 Church Street, New York

Telephones { Cortlandt 2465 / Cortlandt 5618 — Cable Address, Glasdustry

J. B. KRAK, Technical Editor

Subscription Price.....$2.00 a Year
Single Copy.....20 Cents

THE GLASS INDUSTRY circulates extensively among American and foreign glass manufacturers, their business executives and technical and factory operating staffs.

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Have Your Batches Examined

The practice of having a periodical examination has saved the lives of many. Similarly, an impartial examination of the batches in use by glass manufacturers may save the life of a concern. Some batches, while perfectly satisfactory, cost too much in these days of extreme competition. A substitution may save thousands of dollars in raw materials, in storage charges, in fire insurance, and in time. Materials, formerly unknown or too expensive, can now be introduced in the batch profitably. Borax and feldspar are among them. Borax imparts very valuable properties to glass. Its price has dropped to fifty dollars a ton (carload lots), due to availability of new sources of supply. There are still many firms making crystal glass that could use feldspar to advantage. Colors may be produced less expensively than is practiced by some concerns. Few glass manufacturers can afford a chemical laboratory and a trained chemist, but all can afford to have a survey made of their batches, in order to see whether or not they are producing the best glass at the lowest cost.

Reliable consultants can do this at a slight expense out of all proportion to the saving that can be effected. And if no changes are possible one has the satisfaction of knowing that the item of cost of raw materials is at a minimum, consistent with quality desired.

Killing the Goose

The cut glass industry made its exit some years ago, by way of the premium store. Overproduction, the use of pressed blanks, introduction of acid polishing, cheap glass, all combined to lower the price of cut glass to a point where it could be given away. There was large volume production but small profits to the manufacturer. Now nobody wants cut glass. The demand for fine ware has declined to the vanishing point. Thousands of dollars' worth of equipment has been rendered valueless. Hundreds of skilled artisans have seen their livelihood taken away from them. Numerous firms have been forced out of business or have switched to entirely new lines, at a great sacrifice of money and efforts. All this is old history. It is merely revived, as history has a way of repeating itself.

The introduction of color in the glass industry has done more to stimulate popular interest in glass than any one event of the last ten years. While crude at first, colors are now produced in fine pastel shades that are a joy to behold. As long as improvement in design and in color go hand in hand, there will be a profitable market for fine colored glassware. Reference is made to a number of firms making the better grade of this ware, who have expanded their sales and their manufacturing capacity enormously. This has been accomplished by adhering strictly to high class standards, and by advertising that appeals to the discriminating buyer.

The danger in the present situation is the flood of cheap, poorly designed, off-color ware that is coming on the market instead of going to the cullet pile. There is very little profit in this ware to the manufacturer. But the chances are that the public will be surfeited with colored glassware, and that the good will be rejected with the bad.

History may repeat itself and the glass industry may once more kill the goose that lays the golden eggs.

The Nature of Glass

BY ROY E. SWAIN[1]

Webster defines nature as "The essence, essential qualities, or peculiar attributes of a thing, which constitute it what it is, and differentiates it from other things."

In previous articles we have considered some of the more important properties or qualities of molten glass. These qualities vary greatly in the many glasses that have found use in the industry today. They are not alone dependent upon batch formulas for their variations as changes in melting or working schedules often cause decided changes in the working properties of glass. Workmen are quick to notice these changes and differences and speak of glasses having different working properties as different natured glasses.

Viscosity Range

Viscosity variability probably gives the glass worker greater cause for thought than any of the other variable qualities of molten glass. Some glasses appearing to be quite cold and stiff when gathered may be worked slowly with little show of increasing viscosity. These glasses are known as slow setting glasses. These glasses are usually considered best for machine work as they reheat more consistently and are said to "hold the heat well." While they may not be able to retain the heat any better than many other glasses they remain fluid longer, and since experience has taught the glass workers the close relationship between heat and fluidity the meaning of the expression is seldom misunderstood.

The other extreme of these glasses is found in some of the low expansion glasses usually known as heat resisting glasses. These glasses are often worked at a temperature so great that they fairly blind the untrained eye with their incandescence, yet must be worked rapidly to finish the article before the glass sets. These are known as quick setting glasses and from a standpoint of quantity production are considered desirable for hand work. However the iron blow molds and press molds are often short-lived when used in forming ware from these glasses.

All quick setting glasses are not worked at the extremely high temperature mentioned in the preceding paragraph for nearly all of the glasses used in the production of hand blown bottles were worked at a comparatively low temperature yet were quick setting. Two men working together could gather and blow an average of from fifteen to eighteen small bottles per minute over a period of eight and one-half hours. It was with such glass that many of the bottle machines were first tried, but the glass makers soon developed glasses suitable to machine production.

Some glasses remain workable for a greater period of time after being removed from the furnace than others. These glasses may possess a greater specific heat, a lower conductivity of heat, the ability to remain fluid through a greater range of temperature, or a combination of these properties. These glasses are classed by the workmen as slow setting glasses. Other glasses remain workable for only a comparatively short period of time by virtue of their lower specific heat, greater conductivity of heat, or inability to remain fluid over a very great range of temperature. The glassworkers call these glasses quick setting glasses. The terms "quick setting" and "slow setting" can not be defined closely as they are used more as a means of comparison than otherwise.

Soft and Hard Glasses

Some glasses, usually rich in alkali or having a complex composition, melt quickly at low furnace temperatures and are readily worked at low temperature. These glasses are known as soft glasses. There are other glasses that are difficult to melt at extremely high furnace temperatures and require special care and training in working. Such glasses are usually rich in silica or acid content and are known as hard glasses. Between these extremes are countless glasses of various degrees of hardness. These are known as hard or soft glasses according to the uses to be made of them or the melting equipment available for melting them. What would be considered a hard glass in a tableware factory would be classed as a soft glass in a plant manufacturing technical and scientific glassware.

Some glasses lack consistency and are usually classed as "lumpy" by the workmen. Such glasses usually work as though a soft and a hard glass had been melted together without stirring. Thus we have what appears to be lumps of a sluggish glass held suspended in a more fluid glass. It is difficult to gather symmetrical shaped gathers of uniform weight from such glass and even more difficult to secure even distribution in the blown ware. Such glasses may often be worked as pressing glasses with few complaints but be a constant source of trouble and dissatisfaction as blowing glasses.

Week-ends and holidays make it necessary to hold glass idle for considerable periods of time. Glass held in this way seldom has the same working character that the same glass has when worked at its normal working schedule. This glass lacks life, but not in the sense of a glass being worked *at a temperature below* its best working temperature. It has a distinctive "feel" to the gatherer that may be described as coarse textured. The ware made from this glass often appears to lack strength as it is very brittle on the shop and the lehr breakage is high. Some of the common opal glasses have this tendency at all times and are classed as "brash" by the workmen.

In the different plants and branches of the glass trade many descriptive words have been coined to designate the working qualities of the different glasses, but to all glassworkers these working qualities constitute the "nature" of glass.

[1] Engineering Department, Macbeth-Evans Glass Co., Charleroi, Pa.

The Polytechnic Institute, Brooklyn, New York announces through John R. Frierley that an opportunity is now afforded to engineers, chemists, and other technicians located in the New York metropolitan district, to pursue graduate study during the evening hours. For twenty-five years this institution has given undergraduate courses in its evening sessions leading to bachelor and engineer degrees and will further parallel its regular day curricula by offering this fall four graduate courses in the evening, which lead to the master's degree. These courses will permit properly qualified graduates of universities and technical colleges who are engaged during business hours, to continue studies in chemistry and engineering.

Recent Patents

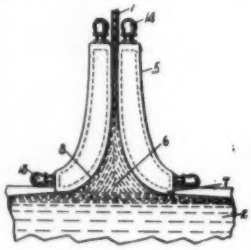
NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

METHOD OF PRODUCING GLASS. U. S. 1,684,332. Sept. 11, 1928. Max Thomas, Weisswasser, Oberlausitz, Germany, assignor to Patent-Treuhand-Gesellschaft Ful Elektrishe Gluhlampen M. B. H., of Berlin, Germany. Filed 6/26/26. It is known that the electrical conductivity of a glass is determined essentially by its alkali oxide content, in particular sodium oxide content. In accordance with the present invention it has been found that glasses which contain silicon dioxide, calcium oxide and at least one oxide of a divalent or trivalent metal are particularly suitable for insulation purposes if iron oxide is used as a flux. The effect of the iron oxide in the glass as regards its electrical conductivity is substantially the same as that of boric acid and is less than that of lead oxide. An example of such a batch is:

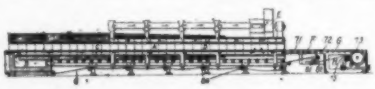
	Per cent by weight.
SiO_2	67
K_2O	3
CaO	10
BaO	10
Fe_2O_3	10

WIDTH MAINTAINER FOR CONTINOUS SHEET GLASS. U. S. 1,681,258. Aug. 21, 1928. Clifford A. Rowley, Toledo, O., assignor to the Libbey-Owens Sheet Glass Company. Filed 3/24/24. The process of maintaining the width of the sheet during its initial forming period, consisting in surrounding the sheet source at its edge in a manner to form a beaded edge portion on the sheet and to continously confine and direct this edge along a predetermined path of travel, and then eliminating the beaded edge while it is still plastic.

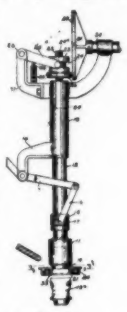


MOLD-CHARGE GUIDE FOR GLASS-FEEDING APPARATUS. U. S. 1,680,391. August 14, 1928. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company. Filed December 3, 1923. One object is to provide a mold charge guide which is mounted independently of the severing device and which is adapted to occupy a stationary operative position adjacent to the mold charge during at least a portion of the severing operation and which will provide an abutment for minimizing lateral motion imparted to the mold charge by the action of the shear blade.

LEHR CONVEYER AND DRIVING MECHANISM. U. S. 1,674,794. June 26, 1928. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Co. Filed 2/12/27. Apparatus for annealing glassware comprising a tunnel, a laterally and longitudinally flexible endless conveyer for transporting articles of glassware through said tunnel, said conveyer having an active or ware-bearing strand extending through said tunnel and also having an idle strand returning to the entrance end of said tunnel, said conveyer comprising alternately arranged sections of right and left-hand wound interconnected wire helixes, a drum which said conveyer initially and frictionally engages at the termination of its active or ware-bearing travel, with a resulting tendency for the successive helically wound wires of each section to be led thereonto laterally offset relative to each other by the twisting or corkscrew action of said wires in conforming to the curvature of said drum, the said drum having a radius sufficiently great to prevent such relative twisting or corkscrew action from causing the section engaging said drum to creep laterally thereon an excessive degree in one direction before the oppositely wound helical wires of the next succeeding section in passing upon said drum, cause said conveyer to creep laterally in the opposite direction.

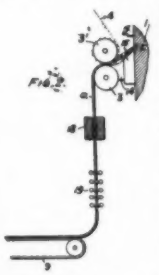


PROCESS OF MANUFACTURING GLASS. U. S. 1,674,366. June 19, 1928. August Kadow and Alvah C. Parker, Toledo, O., assignors to Libbey-Owens Glass Mfg. Co. Filed 4/7/24. The process of severing glass and forming on a glass article an edge that is exposed during the normal use of the article, which consists in melting the glass along the line of severance so quickly that severance results and leaves the glass constituting the exposed edge of the finished article in exactly its original position with regard to the portion of the said article to which it is attached, except for a small amount of glass which is melted and forms a bead along said edge. The process of forming a bead on the edge of hollow glassware, which consists in playing a flame across the edge toward the center of the article while rotating the article, and regulating the speed of rotation and the force of the flame so as to position the bead as desired.

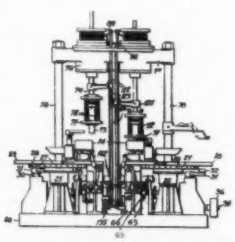


GLASS FEEDER. U. S. 1,678,232. July 24, 1928. Leonard D. Soubier, Toledo, O., assignor to The Owens Bottle Co. Filed 3/3/24. The combination of a container for molten glass having a bottom outlet opening, a regulator projecting into the glass over the opening and controlling the discharge of glass through the opening, a stirring device dipping into the glass at one side of the regulator and substantially directly above the opening to agitate glass adjacent said regulator, and means for continuously rotating the stirring device about an axis at one side of the regulator.

PROCESS AND APPARATUS FOR MAKING SHEET GLASS. U. S. 1,676,772. July 10, 1928. Walter Cox and Arno Shuman, Philadelphia, Pa., assignors to Pennsylvania Wire Glass Co. Filed 1/12/21. Apparatus for making wire glass consisting of the combination of wire mesh embedding and smoothing rolls, a weir provided in the glass tank furnace wall —preferably below the level therein—and discharging between the mesh embedding rolls, and means for continuously supplying wire netting or mesh between the embedding rolls; with or without a rotary cutter on the delivery side of the rolls. After leaving the rolls 3 and 3', the moving sheet of wire glass on its way to the conveyer 9 and lehr, passes through a press, collectively designated 18, in Fig. 2, which operates on the moving sheet while it is in motion and so flattens its surfaces and straightens it. If desired use may be made of a fire polishing burner 19 at the outlet side of the press.

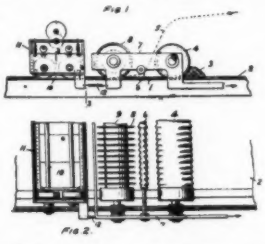


GLASS-PRESSING MACHINE. U. S. 1,680,474. Aug. 14, 1928. Karl E. Peiler and Edward H. Lorenz, West Hartford, Conn., assignors to Hartford-Empire Company. Filed 8/10/18. The units, each comprising a mold table with its rotating and locking mechanisms, and their cooperating shaping mechanism may be operated coincidentally in exact coordination, from a common drive, or the actuating mechanisms of each unit may, without interfering with the operating of the other unit, be stopped or put in action manually whenever desired, and will be stopped automatically if any of the parts fail to act in correct time, or misfeed, or otherwise get out of correct relation. A machine for shaping plastic glass, comprising a rotatable mold table,



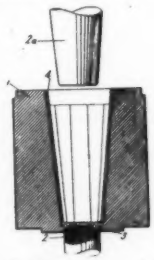
a shaping implement, a revoluble and reciprocatory crank for imparting to the table intermittent rotary movements, into cooperative relation to said implement, mechanism for revolving the crank, mechanism for reciprocating the crank, and means for locking the table between its movements.

METHOD OF MAKING CORRUGATED WIRE GLASS. U. S. 1,676,773. July 10, 1928. Walter Cox and Arno Shuman, Philadelphia, Pa., assignor to Pennsylvania Wire Glass Co. Filed 7/16/27. The invention comprises continuously rolling a lengthwise corrugated sheet of glass, initiating the corrugation of a flat wire mesh by embedding and securing its end in the first formed corrugations of the sheet, permitting the flat portion of the wire mesh to continuously assume corrugated form above the corrugated sheet as the rolling progresses, embedding the wire mesh in corrugated form into the corrugated sheet as the rolling operation progresses, and pressing or patting the roughened surface of the sheet through which the wire has been pressed.



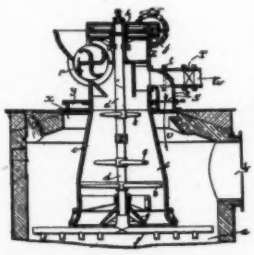
APPARATUS FOR SETTING UP AND TRANSFERRING BOTTLES AND OTHER ARTICLES. U. S. 1,680,283. Aug. 7, 1928. Albert N. Cramer, Toledo, O., assignor to The Owens Bottle Company. Filed March 31, 1924. Apparatus adapted for receiving bottles or other glass articles as they are delivered from a forming machine, and delivering them in an upright position to a conveyor, by which they may be carried to an annealing leer.

APPARATUS FOR FORMING GLASSWARE. U. S. 1,675,971. July 3, 1928. Virgil O. Cornwell, Columbus, O., assignor to Federal Glass Co. Filed 9/18/25. A block mold adapted to form a projection or projections upon the bottom of the article being formed whereby the general bottom of the article will be prevented from contacting with the surface upon which it is to be supported. The result of forming the articles in this manner is to prevent the greater part of the surface of the article, which may be rough or wet, from directly, contacting with supporting surfaces. The finished article will present a smooth bottom surface regardless of the size or sharpness of any fins caused by the pressing of plastic material in any necessary cracks in the mold structure.

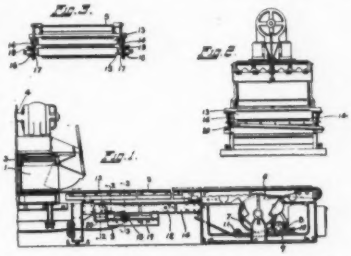


GRINDING AND POLISHING TABLE. U. S. 1,673,903. June 19, 1928. Samuel C. Cripe and John C. Gipe, Toledo, O., assignors to Libbey-Owens Sheet Glass Co. Filed 6/15/25. In sheet glass surfacing apparatus, a glass supporting table top provided with a recess upon its upper surface, and a pad arranged within said table recess and being formed with a sheet receiving recess in its upper surface.

GAS PRODUCER. U. S. 1,679,645. Aug. 7, 1928. George Herbert Bentley and Edmund Gardner Appleby, Westminster, London, England; Geoffrey Edmund Appleby and William Wallace Hargrove, Executors of said Edmund Gardner Appleby, deceased, assignors to said Bentley. Filed 5/20/25. According to this invention an agitator is provided a short distance, say one and a half inches, below the lower end of the distillation chamber which agitator rotates in and maintains the fuel at an even level in the gas generating chamber. Preferably the agitators in the distillation chamber are secured to a central vertical shaft at the end of which is suspended the agitator in the gas generating chamber. Preferably also a fuel spreading bell is fixed to the agitator shaft. The distillation chamber is preferably half the diameter of the gas generating chamber.



CULLET DUMP FOR LEHRS. U. S. 1,680,361. Aug. 14, 1928. Thomas E. Beach, Baltimore, Md., assignor to Hartford-Empire Co. Filed 12/19/27. The combination with an elongate tunnel lehr for annealing glassware, an endless flexible belt for conveying the ware there through, an open ware cooling and sorting table over which said belt travels, and driving means for said belt, of an S-turn in the return strand of said belt beneath said sorting table, the upper loop of the S being directed toward the direction of motion of said strand, and a receptacle for catching any cullet dumped from said strand located beneath said upper loop.



SHEET-GLASS-DRAWING APPARATUS. U. S. 1,680,240. Aug. 7, 1928. Lewis D. Blackshere, Charleston, W. Va., assignor to The Libbey-Owens Sheet Glass Company. Filed 8/17/27. Suitable insulating material such as indicated at 19 may be arranged within the channel-shaped rails 15 and a heat resisting plate or slab 20 may be secured to the underside of said rails. The combination with an endless sheet glass drawing apparatus draw table having a sheet carrying run and a return run, and means for heating the table during its return run, of means for protecting the table from the heating means during its sheet supporting run.

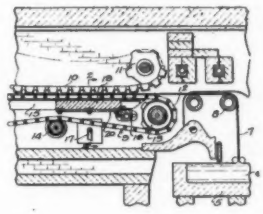
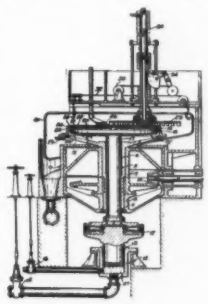
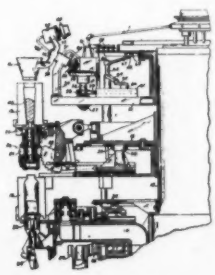


PLATE-GLASS-ROLLING APPARATUS. U. S. 1,676,056. July 3, 1928. Lee Showers, Charleroi, Pa., assignor to Pittsburgh Plate Glass Co. Filed 1/29/27. A device for use in connection with an intermittent rolling machine, such as that shown in Patent No. 1,579,666, issued April 6, 1926.

GLASS-SURFACING APPARATUS. U. S. 1,673,910. June 19, 1928. John C. Gipe, Toledo, O., assignor to Libbey-Owens Sheet Glass Co. Filed 2/15/26. A glass sheet surfacing apparatus in which glass sheets are positioned for grinding, showing the improved device. Comprising a rotatable sheet supporting table, a cushion associated with the table upon which the glass sheet rests, a sheet retainer forming an elevated ledge around and apart from the table and cushion, and means for raising or lowering as a unit the table, cushion and glass sheet within said retainer. One object of the inventor is to improve the quality of the work and reduce its cost.



GLASS MOLD MECHANISM. U. S. 1,674,997. June 26, 1928. Charles E. Schmunk, Crafton, Pa. Filed 12/6/24.



GLASS-FORMING MACHINE. U. S. 1,678,233. July 24, 1928. Leonard D. Soubier, Toledo, O., assignor to The Owens Bottle Company. Filed 4/8/26. A glass forming machine comprising in combination, a rotary mold carriage, a mold thereon open at its upper end to receive a charge of glass, a guide for directing the charge into the mold, a carrier for the guide, mounted on the mold carriage and means to oscillate the carrier about a non-vertical axis and thereby alternately lift and lower the guide out of and into a position over and in register with the mold.

Corning Glass Works Has Seen Sixty Birthdays

The sixtieth anniversary of the Corning Glass Works was celebrated at Corning, New York during the past month on a quite extensive scale. On Thursday evening, September 13 a dinner was given at the Masonic Cathedral to invited guests and those of the employees of the company who had given to it fifteen years or more of continuous service.

Several hundred men and women were honored for their loyalty and faithfulness. There was a total of 131 in the 15-year group. There were 4 in the 45-year group, and 11 in the 40-year group; 41 in the 35-year group, 28 in the 30-year group, 63 in the 25-year group, and 97 in the 20-year group. As these men filed before Dr. Eugene C. Sullivan, the works executive, they constituted "the very life thread of Corning Glass Works."

At the opening ceremony, Amory Houghton read cables from London from Ambassador Alanson B. Houghton, and Alexander D. Falck, chairman of the board and president, respectively, of the company, complimenting the men and regretting that they could not be present. Whiting Williams, a well-known industrial relations expert addressed the gathering.

Referring to a visit he had made to Russia he said:

"The Russians are tremendously interested in American industry and they think that its success is due to the machinery used. They worship American industrial machinery.

"But the secret of American industrial prosperity is not the machinery, it is the wonderful co-operative relations which exist between the men who own, and the men who run the machinery.

"This co-operation and this respect between owner and worker have made Corning Glass Works what it is today, and to look into the future, this amiable relation is what will make the Company 60 years hence look back upon the year of 1928 with the same pride that we today are looking back to 1868."

Dr. Sullivan stated that the original plans for the banquet had included the ten-year men but that their presence would have doubled the number of diners and there was no hall in Corning large enough to supply accommodations. He announced that the ten-year men would be awarded their buttons at the glass works field day exercises on the following Saturday afternoon. He stated that out of a total of 2,000 employees there were 770 who have been serving the company for more than ten years, which is more than 40 per cent. As reported in the Corning *"Evening Leader"* he said: "These figures are a credit to the Company, and also to the workers, who are loyal and who know their own minds. They are not swayed by every idle wind that blows. They have made Corning Glass Works one big family, whose password is cooperation.

"They represent stability, skill, experience and influence to their associates, who look to them for guidance and example.

"Extended service, however, creates the danger of getting in the rut and not being progressive, which can be guarded against by the industrial panacea, co-operation.

"The individual prospers, only as the company for which he works prospers, and each man helps himself best by helping his organization."

Presents Service Buttons

Dr. Sullivan then described and presented the service buttons, which consist of white enamel on a field of blue, with C. G. W. in gold letters appearing upon the white. The service record up to 35 years is indicated by gold stars, each star indicating five years.

Records of 35 years, and above, are indicated with jewels; 35 years being one ruby; 40 years, two rubies; 45 years, one diamond and 50 years, two diamonds.

"I take great pleasure," declared Dr. Sullivan, "in presenting these badges of service, and wish each veteran to consider C. G. W. the initials of a friend."

In introducing the main speaker of the evening, Walter Cary, first vice-president of the Westinghouse Lamp Company, which is the Glass Works' largest customer, Toastmaster Houghton dwelt upon the pleasant relations which exist between the two firms, and said he liked to consider the Glass Works not as an outside company selling lamps to Westinghouse, but as the glass division of the Westinghouse Company.

Mr. Cary Speaks

Mr. Cary evidently caught the idea, for he declared that the existence of such relationship entitled him to a 20 year Glass Works service button, and accordingly he was presented with one.

"I bring," he said, "a message from the Westinghouse Lamp Company to Corning Glass Works. These two companies have enjoyed a long period of profitable business relationship. There have been some difficulties and some difference of opinion; but every knot and gnarl has been settled on a fair and square basis with satisfaction to all.

"There are very few corporations in the country which have endured for 60 years with no change in their general corporate organization.

"The Corning Glass Works has descended through three or four generations, and still maintains its identity as one of the most prosperous glass manufacturers in the world.

"This condition is unusual. Most heirloom businesses run down hill and stagnate as they pass from father to son. But with the Corning Glass Works, each inheritor has proven worthy of his estate, and striven to build and improve the business.

"I attribute this success of the Glass Works to the fact that the owners have not been selfish. They have surrounded themselves with able associates, whom they have allowed to grow into the business, and whom they have promoted to positions of responsibility.

"The finances of a business may be raised in a short time and the buildings erected and machines installed with no great trouble, but an organization, thriving on good will and cooperation, is the work of a lifetime.

Happiness True Quest

"All men seek riches. It is human to want what we do not have. But after all, the true quest of life is happiness; and a man will derive his greatest happiness by the building up of a stable and co-operative business.

"The veterans present tonight represent the highest class of workers. They are men with background, and the products of natural selection. Men who are continually moving from place to place never advance very far.

"Experienced workers learn that they never get very far, if they work a'one. They must have co-operation. A genius in business would starve, if he depended on his own single efforts.

"The veterans of the Corning Glass Works are rich in experience, and should be divinely happy in their contribution to the general welfare of the company for which they work, and I leave them with the words of Rip Van Winkle, 'May you live long and prosper.'"

New Publications

Transmissive Properties of Eye-Protective Glasses and Other Substances. Technologic paper No. 369 of the Bureau of Standards, by W. W. Coblentz Physicist, and R. Stair, junior physicist. Contents include discussions of tinted glasses for absorbing some of the ultra-violet, special glasses for protecting the eye from injurious radiation, and various miscellaneous substances. Copies may be obtained from the Superintendent of Documents, Washington, D. C., at 10 cents each.

Barium Carbonate. Report of the United States Tariff Commission to the President of the United States showing differences in costs of production of barium carbonate in the United States and in the principal competing country. Includes the President's proclamation increasing the duty on barium carbonate, precipitated, from 1 cent per pound to 1½ cents per pound.

British Standard Specifications for Translucent Glassware. Illumination Fittings for Interior Lighting; No. 324-1928. Obtainable from the British Engineering Standards Association, 28, Victoria Street, London, S.W. Price 2s. net; post free, 2s.

United States Government Master Specifications Alphabetical Index and Numerical List, promulgated by the Federal Specifications Board and complete to January 21, 1928. This constitutes circular No. 319 of the Bureau of Standards.

The Glass World and What It Is Doing

News of the Industry

Announces Rise in Window Glass Prices

The American Window Glass Company has announced new discounts on flat window glass effective October 1. Applied to carload shipments into all United States zones, the new discounts increase prices one point, equivalent to about 8 to 9 per cent.

The discounts from manufacturers list of April 23, 1928 are as given below:

Single strength B, Fourth and C qualities—1st bracket, 88 per cent.

Single strength B, Fourth and C qualities above brackets 87 per cent.

Double strength B quality—all brackets, 87 per cent.

A quality single strength and double strength, packed with or without paper, two points higher than B quality.

Single strength C quality is sold subject to certain size limitations.

Injunction Prevents Reduction of Sand Duties

Statements having been circulated to the effect that the duty of $4.00 per ton applied on glass sand containing more than 99% silica, announced by the Bureau of Customs on June 16, 1928 (noted in the July issue), had been reversed at the request of Pacific Coast glass manufacturers, THE GLASS INDUSTRY in order to learn the facts made inquiry as to the situation and was advised on September 1 by J. D. Nevius, Deputy Commissioner of Customs, that the Treasury Department at Washington had recently ruled that Belgian sand is free of duty thus reversing its decision T. D. 42820, mentioned above, and that this sand is properly dutiable as silica under paragraph 207 of the Tariff Act. The Department had been giving this question consideration following protests received from California importers of Belgian sand, but domestic interests have filed an injunction in the Supreme Court of the District of Columbia to restrain the Department from making any decision authorizing the free entry of the sand. Pending the result of the Court's decision on the application no action will be taken by the Department.

A Puzzle Mirror of Practical Value

Reports have been in circulation for some time past that a so-called "one-way" sheet glass is being produced through which an observer may look and see what is going on, on the other side, without being seen himself through the glass. It seems probable that these references are to "Miroirs Argus" (Argus Mirrors), which are used in large quantities in France. The Argus mirrors are made of two sheets of flat glass in close contact which each other, the inner contacting surfaces being "platinized." The arrangement is such that when the surface of the mirror is exposed to the light, and the back side is turned toward a dark room, the front surface looks exactly like and has the same properties as an ordinary mirror. The back surface, which looks more like a piece of plate glass than an ordinary mirror, enables the person or persons in the dark room to see clearly all that is going on in the lighted room.

Because of the platinized surface the person or persons standing in the dark room behind the back side of the Argus mirrors are invisible to the persons standing in the lighted room. The Argus mirrors can therefore help in detecting the goings on in the outer or lighted room.

In Europe these mirrors are extensively used as detective-mirrors. For instance in a large jewelry store a pillar or an inconspicuous corner may be glazed with one of these mirrors and the watchman behind the mirror can see everything happening in the store without being seen himself and is thus enabled to detect the doings of the parties who come to the store with not such clean intention.

The Argus mirrors can also be used to a great advantage as an advertising medium. This can be explained as follows:

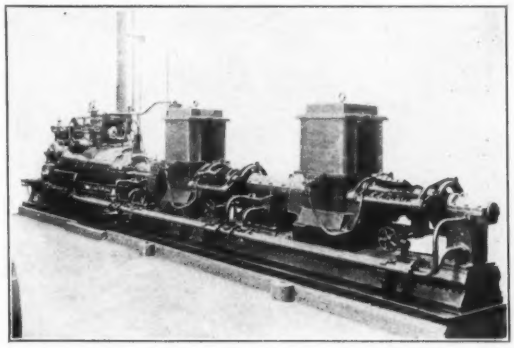
An electric sign with an intermittent current may be placed behind the side of the Argus mirror in the dark room and the persons attracted by the mirror or the front side of the Argus Mirror are captivated by the signs appearing behind the mirror.

These novel mirrors are supplied by the San Gobain Company of France through J. Vaurie, 1 Madison Avenue, New York.

Oldest Turbine Machine Found in Michigan

In due time a turbine, the oldest known, which was discovered in the Wyandotte, Michigan, plant of the Pennsylvania Salt Manufacturing Company will be seen in operation in the new mechanical museum or collection of "mechanical firsts," which Henry Ford is establishing.

Having heard of this old engine Mr. Ford called there recently and after examining the machine said that he would like very much to include it in his collection, especially as its history was so clear and definite.



THE OLD TURBINE

A request was sent to the officers of the Pennsylvania Salt Manufacturing Company, and the board of directors, by formal resolution, presented the turbine to Mr. Ford.

This combined turbine engine and generator, was built to order by the Parsons Company, of Newcastle-on-Tyne, England, in 1902, and cost $30,000. Its capacity is 350 K.W., or 470 E.H.P., and it covers a floor space of 5 x 30 feet.

It is still in running order, and stands at one end of what is called the Old Engine Room.

That Punxsutawney Tank

An item published in September issue, page 212, entitled "A Record Breaking Tank," describes a tank that W. T. Tibby, general manager of the Tibby-Brawner Glass Company, Punxsutawney, Pa., believed had given the longest continuous service of any glass tank ever known in the industry. To the same article was appended an item from a local paper stating that the Brockway Machine Bottle Company had a tank at Brockway, Pa., that has been running continuously for seven years. It has since been pointed out that while the Tibby-Brawner tank was actually in use without being shut down for repairs of any kind during a continuous run of five years, the Brockway Company item meant that their *plant* was in continuous operation for seven years without a shut-down. This could be accomplished by operating two or three tanks alternately. In the Tibby-Brawner case reference was made to a certain tank, while in the Brockway case the local newspaper reference was to the effect that the factory had been in continuous operation for seven years. It is hoped that this will clarify any misunderstanding resulting from the statement in the September number.

Unusual Patent Situation Disclosed by Suit

In an appeal by the Ashland Fire Brick Company against a decision given General Refractories Company in the Circuit Court of Appeals for the Sixth Circuit, the decision of the lower court was reversed. The court held that the defense of an intervening right as against claim 10 of reissue Patent No. 15889, August 12, 1924, was a good defense, in reversing the decision of the lower court. The court stated that because the claims of the original patent were limited and after its issue defendant, relying upon the limited character of the claims, built noninfringing brick machines before the reissue of the patent, at least a right to continue to use these machines was acquired as if a license therefor under the reissued patent was held. The suit involved a brick press, a repress, a brick conveyor from the first to the second press, and an interposed trimmer for removing the excess material remaining after the first press.

August Construction Statistics

Construction contracts to the amount of $516,970,200 were awarded last month in the 37 states east of the Rocky Mountains, according to F. W. Dodge Corporation. These states include about 91 per cent of the total construction volume of the country. The decline from July of this year was about $66,000,000, or 11 per cent. The decrease from August of last year was about $35,000,000, or 6 per cent. The New England States and the Northwest were the only two districts showing increases over their July, 1928, records, and the Central West, Northwest and Southeastern States were the districts showing increases over their August, 1927, records.

Tariff Increase on Sodium Silicofluoride

On the recommendation of the Tariff Commission, President Coolidge has issued a proclamation changing the duty on sodium silicofluoride from 25% ad valorem based on foreign market value, to 25% ad valorem based on selling prices in the United States. The increases were requested by the Oconee Alkali Company, Athens, Ga., and the Southern Alkali & Chemical Company, Savannah, Ga. An investigation conducted by the Tariff Commission had shown that sodium silicofluoride was imported chiefly from Denmark and Holland and that production costs in this country exceeded those of the two countries named.

Trend of the Mirror Business

Nineteen mirror manufacturers responded to the Trade Barometer questionnaire conducted by Harry C. Sorden, Secretary of the National Association of Mirror Manufacturers, to ascertain the amount of glass silvered during the previous month and reported for August, 1928, the total of 356,080 square feet and the total for July, 1928, 292,933 square feet. Production was 389,029 square feet in August, 1927. Some reported business much better, others poor; collections poor. "September looks good."

Heavy Increase in Plate Glass Production

From figures compiled by P. A. Hughes, secretary of the Plate Glass Manufacturers of America, the production of polished plate glass for the month of August, 1928, was 11,473,697 sq. ft., as compared with 9,346,069 sq. ft. produced in the preceding month, July, 1928. The production for the corresponding month last year, August, 1927, was 10,615,978 sq. ft.

American Refractories Institute

The American Refractories Institute's fall meeting will be held on October 24, 1928, in the Vanderbilt Hotel, New York (instead of Pittsburgh). The meeting will be devoted to the discussion of specifications and will be a continuation of the specification symposium held during the Association's meeting last spring at White Sulphur Springs.

Soda Ash Prices Advanced in Germany

The Syndicate of German Soda Ash Manufacturers, G.m.b.H., with headquarters at Bernburg (Anhalt) June 30, 1928, increased the price of soda ash by 3 per cent. It is reported that the German price of caustic soda may be increased shortly.

Harry M. Thompson Badly Injured

Harry M. Thompson, secretary and treasurer of the Simplex Engineering Company, Washington, Pa., met with a very serious accident near Dubois, Pa., on September 13. His machine was found in a creek some distance from the road and Mr. Thompson when found was unconscious and in a serious condition. He was taken to the Dubois Hospital and later reports stated that he was showing improvement.

Trade Activities

The American Window Glass Company are now operating a second large tank at their Jeannette, Pa., plant.

The Cambridge Glass Company, Cambridge, O. has reached a settlement with their force of carry-in employees which had been on strike, who returned to work on Monday, September 17.

The Eureka Art Glass Company, Milton, W. Va., has purchased materials for a new building and ground has been broken for the new plant. They would be interested in receiving information regarding a cutting-off machine and grinding outfit.

The Duplate Safety Glass Company of Canada is reported to have been organized to manufacture non-shatterable glass with exclusive rights in Canada under license to use the processes controlled by the Pittsburgh Plate Glass Company and the Dupont Company.

The D. O. Cunningham Glass Company, Pittsburgh, Pa., have let a contract for a new tank to H. L. Dixon Company. It is slightly larger than the tank that has been torn down and will accommodate two Hartford-Empire feeders and machines now in the plant.

J. J. K. Kelley has been appointed manager of the promotional activities of the recently organized Flat Glass Manufacturers Bureau. Mr. Kelley is sales manager of the Blackford Window Glass Company and also represents the Blue Ridge Glass Corporation of Kingsport, Tenn.

The Pedersen Glass Company is reported to have been incorporated in the state of West Virginia with a capital of $150,000, by I. O. Pedersen, Wilkinsburg, Pa., R. C. Hamerly, Swissville, Pa., Frank B. Beech, Pittsburgh, E. G. Stahl, Lumberport, W. Va., and Bernard Summers, Mt. Lebanon, Pa.

The Paramount Glass Company factory at Star City, W. Va., owned by S. Kipinski and his sons John and Joseph was destroyed by fire on September 11 with a loss estimated at approximately $50,000. The factory had been in operation for a number of years and included in the equipment were five day tanks used for clear and colored glassware.

The T. C. Wheaton Company, Millville, N. J., have announced the purchase of the Fay & Schueler Label Company, St. Louis, Mo. The stock on hand is being transferred to Millville and the business will be carried on at that point. The newly acquired line of glass and celluloid labels, shelf bottles and other specialties will fit in well with the present productions of the T. C. Wheaton Company.

The Bausch & Lomb Optical Company of Rochester, N. Y., reached its 75th anniversary this year. The occasion was appropriately observed in the house organ of the company, the *Bausch & Lomb Magazine*. The accomplishments of this great organization in developing the manufacture of high grade products, especially in the line of lenses, in this country is well known and the success of its founders' efforts is best attested by the great growth of the institution during its three-quarter century existence.

Edward Miller, of Miller Machine & Mold Works, Columbus, O., with the employees of that company to the number of about 100, held a very enoyable picnic on the Columbia Club grounds near Lancaster, O., on September 8. All the usual accessories and some unusual ones that go with such events were provided in abundance and everbody had a good time at card games, horse-shoe contests for the men, races for the children, fishing for those who wished it and a baseball game. An orchestra provided music for dancing.

The Glass Consolidated Corporation, Alton, Ill., has obtained, it is reported, a charter for a general manufacturing and mercantile business with $5,000,000 common stock, $4,000,000 first preferred, $6,000,000 second preferred. The same incorporators are given a charter for the Illinois Carton and Label Company, $100,000 common stock and include W. E. Levis, E. J. Varile and F. C. Moorfoot, incorporators.

Coming Meetings

American Refractories Institute, Fall meeting October 24 at the Vanderbilt Hotel, New York (instead of Pittsburgh).

The American Ceramic Society, Pittsburgh Section will meet Tuesday evening, October 9 in the Fellows Room of the Mellon Institute. Prof. Alexander Silverman, head of the Department of Chemistry, University of Pittsburgh, will speak on "The Art and Manufacture of Glass in Europe."

The Society of Industrial Engineers will hold their fifteenth national convention at Rochester. The general theme of the convention will be "Profitable Prosperity"—a practical program for cutting costs and raising profits. Program and complete information may be obtained from the office of the Society, 205 West Wacker Drive, Chicago.

The American Bottlers of Carbonated Beverages will hold their annual convention and exposition November 12-16 in the Detroit (Mich.) Convention Hall.

Recent Deaths

John Rau

John Rau, age seventy-two, founder of the Fairmount Glass Works, died of heart disease Monday night September 10, 1928, at his home, 1504 Park Avenue, Indianapolis, Indiana. He had been in impaired health for three years.

At the time of his death, Mr. Rau was vice-president and chairman of the board of directors of the Fairmount Glass Works, having retired from the presidency of the firm in 1925.

Mr. Rau had been connected with the glass industry practically all his life, having started to work in a Louisville, Kentucky, glass works at the age of nine. Later he worked in plants in Milwaukee, Golden, Colo., and Massillon, Ohio, and in 1889 was instrumental in establishing the Fairmount Glass Works at Fairmount, Indiana. Later the plant was removed to Indianapolis where it is now in operation.

Mr. Rau designed and built one of the first continuous tanks in the United States and he held many patents involving various phases of bottle making. He also invented machines for the manufacture of bottles and his company was the first to make, by machine, bottles of from one to five-gallon capacity.

He was one of the incorporators and president until 1923 of both the Bi-Focal Lens Company and the Twin Sight Optical Company of Indianapolis.

In 1883 Mr. Rau married Miss Alice Marsh of Louisville. She and three children survive him. They are, a daughter, Mrs. Kenneth K. Woolling, and two sons, John H. Rau, and Charles D. Rau, who are president and secretary-treasurer respectively, of the Fairmount Glass Works.

Haller H. Dawson

Haller H. Dawson formerly superintendent of the Clarksburg, W. Va., plant of the Hazel-Atlas Glass Company, died September 4 at Indiana, Pa.

Inquiries Received

For further information address THE GLASS INDUSTRY

431. Please give us the names of makers of opalescent glass.

432. (Germany). We desire to obtain the names of American manufacturers of machines for the making of tank blocks, using a press and vacuum.

433. I would like to have the address of the companies from which shears for feeders can be obtained.

434. Where can we obtain 10 oz. taper shell ginger ale glasses.

435. Where can I get a book giving information on cutting designs in glass, and where can the necessary materials be bought.

436. We should be interested to receive information regarding a cutting-off machine and grinding outfit.

437. We are in the market for a cullet crusher.

What The World Wants

Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C.

Germany: 33536, milk bottles.

South Africa: A list of bottling works, BE-6553, may be obtained from the Bureau of Foreign and Domestic Commerce, Washington.

Ecuador: 33,233, drinking glasses and glass jars.

India: 33,247, glassware.

England: 33,370, china and glass of all descriptions, excluding window glass.

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, SEPTEMBER 15, 1928.
Reported by Moore, Leonard & Lynch, Union Trust Bldg., Pittsburgh, Pa.

	Bid	Asked	Last
American Window Glass Mch., Com.....	32½	35½	33
American Window Glass Mch., Pfd.....	..	..	49¾
American Window Glass, Pfd.....	..	..	85
United States Glass.....	12	..	12
Standard Plate Glass, Com.....	..	290	288
Standard Plate Glass:			
Pfd. Cumulative	..	..	19⅞
Prior Pfd.	38	..	40

TOLEDO, O., SEPTEMBER 20, 1928.

	Bid	Asked	Last
Owens Bottle, Pfd.....	115	..	115
Libbey-Owens Sheet Glass, Com.....	132½	136	135
Libbey-Owens Sheet Glass, Pfd.....	116¼	..	117

WHEELING STOCK EXCHANGE, SEPTEMBER 20, 1928.

	Bid	Asked	Last
Hazel-Atlas	88	88½	88½
Imperial	..	..	72
Fostoria	232	..	208
Central	..	..	75
Jefferson, Pfd.....	..	..	96

READERS' WANTS AND OFFERS

WANTED—Miller toggle semi-automatic press suitable for nappies up to ten inch. Also small side lever rotary press suitable for lids and small articles. Address W-1, care of The Glass Industry, 50 Church Street, New York.

For Sale: CULLET of all Descriptions
Free from Caps, Wires, etc.
GEORGE F. BAUMANN, Dealer,
1110 Carroll Street, Brooklyn, New York.
Carloads Ready for Immediate Shipment.

Will Pay Premium for Back Numbers of
THE GLASS INDUSTRY
Vol. 2, No. 5 (May), 1921
Vol. 2, No. 6 (June), 1921
Vol. 4, No. 1 (January), 1923
Also Complete Sets or Bound Volumes of the Issues of 1921, 1923, 1924
Address, 50 Church Street, New York

Current Prices of Glass-Making Materials

September 20, 1928

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.46	.46
Hydrochloric (HCl) 20° tanks, per 100 lb.		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10–.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	.38	.38
Alcohol, denatured	gal.	..	.53
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½–.05	.05½–.06
Aluminum oxide (Al_2O_3)	lb	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.21
Ammonia water (NH_4OH) 26° drums	lb.	.03	.03¼
Antimony, metallic (Sb)	lb.	..	.10⅛
Antimony oxide (Sb_2O_3)	lb.	..	.13
Antimony sulphide (Sb_2S_3)	lb.	..	.13
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.05
Barium carbonate ($BaCO_3$)			
Precipitated	ton	57.50	60.00
Natural, powdered, imported	ton	45.00	50.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08¼	.08½
Barium selenite ($BaSeO_3$)	lb.	..	..
Barium sulphate, in bags	ton	28.00-35.00	..
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point,	ton	..	16.00
Bone ash	carlots, lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.02½–.03½	.02¾–.03¾
Boric acid (H_3BO_3)	lb.	.07–.07¼	.07¼–.07¾
Refined	lb	.07–.07¼	.07¼–.08
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	.75-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.27	.28
Cobalt oxide (Co_3O_4)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25-.30
Black prepared	lb.	.	.30
Cryolite ($Na_3Al F_6$) Natural Greenland Kryolith)	lb.	.09	.10-.10½
Artificial or Chemical	lb.		.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.15-1.30
Feldspar—			
100 mesh	ton	13.00-20.00	15.50-22.00
80 mesh	ton	11.00-11.75	14.50
40 mesh	ton	11.00	13.50
Fluorspar (CaF_2) domestic, ground, 95–98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Formaldehyde	lb.	.08	.08½
Graphite (C)	lb	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.03–.03½
Black (FeO)	lb.	.03½	..
Kaolin (f.o.b. mine)	ton	9.00	..
English, lump, f.o.b. New York	ton	14.50–25.00	24.50–30.00
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.087-.09¾	.09¾-.10
Litharge (PbO)	lb.	.077-.08¾	.08¾-.09
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	11.50-12.50	..
Burnt (CaO) ground, in bulk	ton	8.00	..
Burnt, ground, in paper sacks	ton	10.00-11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15–2.25	2.30–2.60
Limestone ($CaCO_3$)		2.00	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.08
Manganese 85% (MnO_2)	lb.	.04	.04½
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	23.00–28.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08½	.09
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	06⅝	.07⅛
Hydrated 80-85%	lb.	.06	.06½
Potassium chromate (K_2CrO_4)	lb.	..	.26
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.10
Potassium nitrate (KNO_3) (gran.)	lb.	..	.05⅞-.06
Potassium permanganate ($KMnO_4$)	lb.	.15	.16
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.23
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	19.00-22.00	..
Selenium (Se)	lb.	..	1.90-2.00
Silver nitrate ($AgNO_3$) (100 oz.) per oz.		..	.39½
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.22½	..
In barrels	Per 100 lb.	1.55–1.57½	2.40
In bags	Per 100 lb.	1.37½–1.40	..
Spot orders .. .05 per 100 lbs. higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07	.07¼
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.90	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04½
95 per cent.	Per 100 lb.	2.12½–2.19½	2.50
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.50
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.38½	..
Tin oxide (SnO_2) in bbls.	lb.	..	.53
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.50-2.25
Zinc oxide (ZnO)	lb.	.06½–.08½	.12
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½–.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to August 24, 1928

	July 1927 Quantity	July 1927 Value	July 1928 Quantity	July 1928 Value	Seven Months Ending July 1927 Quantity	Seven Months Ending July 1927 Value	Seven Months Ending July 1928 Quantity	Seven Months Ending July 1928 Value
Glass and glass products (total)	.....	$750.044	.....	$1,017,385	.....	$5,178,910	.....	$5,789,295
Plate and window glass—								
Window glass, common, box 50 sq. ft.	3,427	11,416	1,094	10,760	13,745	74,706	10,160	62,098
Plate glass, unsilvered, sq. ft.	41,956	20,549	207,203	62,134	549,260	180,925	1,322,346	401,741
Other window and plate glass lbs.	296,678	32,203	171,298	16,616	2,697,251	262,499	1,802,220	207,544
Glass containers (bottles, vials and jars)	.....	280,607	.....	429,523	.....	1,789,242	.....	2,134,909
Table glassware, plain	.....	103,733	.....	125,974	.....	852,240	.....	773,894
Table and other glassware, cut or engraved	.....	8,468	.....	34,967	.....	77,730	.....	91,037
Lamp chimneys and lantern globes lbs.	155,733	29,077	111,460	25,867	1,219,286	248,859	1,079,072	214,626
Globes and shades for lighting fixtures lbs.	163,508	57,078	150,486	54,236	1,017,630	370,321	960,421	357,889
Chemical glassware lbs.	29,558	21,138	21,570	21,577	117,269	107,306	122,506	110,502
Electrical glassware, except for lighting lbs.	281,435	29,647	389,400	31,379	1,482,182	143,592	2,864,150	230,171
Other glassware	.....	156,128	.....	204,352	.....	1,071,490	.....	1,204,884

IMPORTS

Corrected to August 24, 1928

Glass and glass products	.....	$1,312,569	.....	$1,313,395	.....	$9,576,037	.....	$8,075,460
Cylinder, crown and sheet—								
Unpolished—								
Weighing less than 80 pounds per case dut. lb.	4,494,516	106,503	1,995,290	49,933	29,041,186	747,666	19,643,460	556,119
Weighing 80 pounds or over per case dut. lb.	2,694,305	93,439	2,047,921	105,784	25,020,018	1,083,186	19,707,734	876,073
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	15,646	.....	54,217	.....	220,620	.....	311,249
Plate glass—								
Polished, unsilvered dut. sq. ft.	1,038,758	269,471	1,106,762	226,831	9,869,869	2,875,081	8,933,483	1,945,306
Other dut. sq. ft.	69,042	18,240	218,835	62,643	667,879	161,553	947,062	241,642
Bottles, vials, jars, demijohns and carboys, molded or pressed dut.	.....	13,102	.....	23,574	.....	111,436	.....	126,658
Table and kitchen utensils dut.	.....	8,641	.....	22,873	.....	66,575	.....	155,328
Glassware, cut or decorated dut.	.....	306,779	.....	237,137	.....	1,948,397	.....	1,432,932
Blown glassware, n. e. s.—								
Bottles, ornaments, gauge glasses and other n. e. s. dut.	.....	250,712	.....	279,485	.....	659,183	.....	744,416
Bulbs for electric lamps dut. No.	950,625	9,764	1,314,499	14,860	8,396,301	79,468	7,777,351	80,946
Chimneys, globes, shades, prisms and other illuminating glassware dut.	.....	68,096	.....	80,106	.....	497,857	.....	512,023
Articles and utensils for chemical, scientific, and experimental purposes dut.	.....	38,565	.....	49,468	.....	307,453	.....	316,181
Other glassware dut.	.....	113,611	.....	106,484	.....	817,562	.....	776,587